

IMPROVING GAS ADVOCACY

IGU launches Global
Gas Portal





Rock to light.

Leaving no stone unturned in our relentless quest to provide energy to light up the world.



To deliver essential energy to a growing population, PETRONAS constantly examines new ways to unleash gas resources. From the furthest corners of the globe, deep into shale and coal-bed formations and out in remote and difficult fields, we are applying new and innovative technologies to monetize hydrocarbon molecules. Building on 40 years of oil and gas experience, PETRONAS is developing one of the world's first floating LNG and other large scale liquefaction facilities to reliably and safely supply the energy needed to light up megacities like Tokyo, Seoul and Shanghai.

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International Gas

OCTOBER 2014 – MARCH 2015

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in conjunction with the International Gas Union (IGU).

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Vision, Mission and Objectives

The International Gas Union (IGU) is a world-wide, non-profit organisation promoting the progress of the gas industry. Through its many member countries representing approximately 95% of global gas sales, IGU covers all aspects of the natural gas industry.

Vision

IGU shall be the most influential, effective and independent non-profit organisation serving as the spokesperson for the gas industry worldwide.

Mission

- ◆ IGU will advocate for natural gas as an integral part of a sustainable global energy system.
- ◆ IGU will promote the political, technical and economic progress of the global gas industry, directly and through its members and in collaboration with other multilateral organisations.
- ◆ IGU will work to improve the competitiveness of gas in the world energy markets by promoting the development and application of new technologies and best practices, while emphasising sound environmental performance, safety and efficiency across the entire value chain.
- ◆ IGU will support and facilitate the global transfer of technology and know-how.
- ◆ IGU will maximise the value of its services to members and other stakeholders.

Objectives

In striving towards the vision and fulfilling the mission, IGU will regarding:

ECONOMY Promote all activities within the entire gas chain, which can add to the technical and economic progress of gas;

CUSTOMERS Encourage development of good customer services and customer relations;

TECHNOLOGY Encourage research and development towards new and better technologies for the gas community;

SAFETY Promote the safe production, transmission, distribution and utilisation of gas;

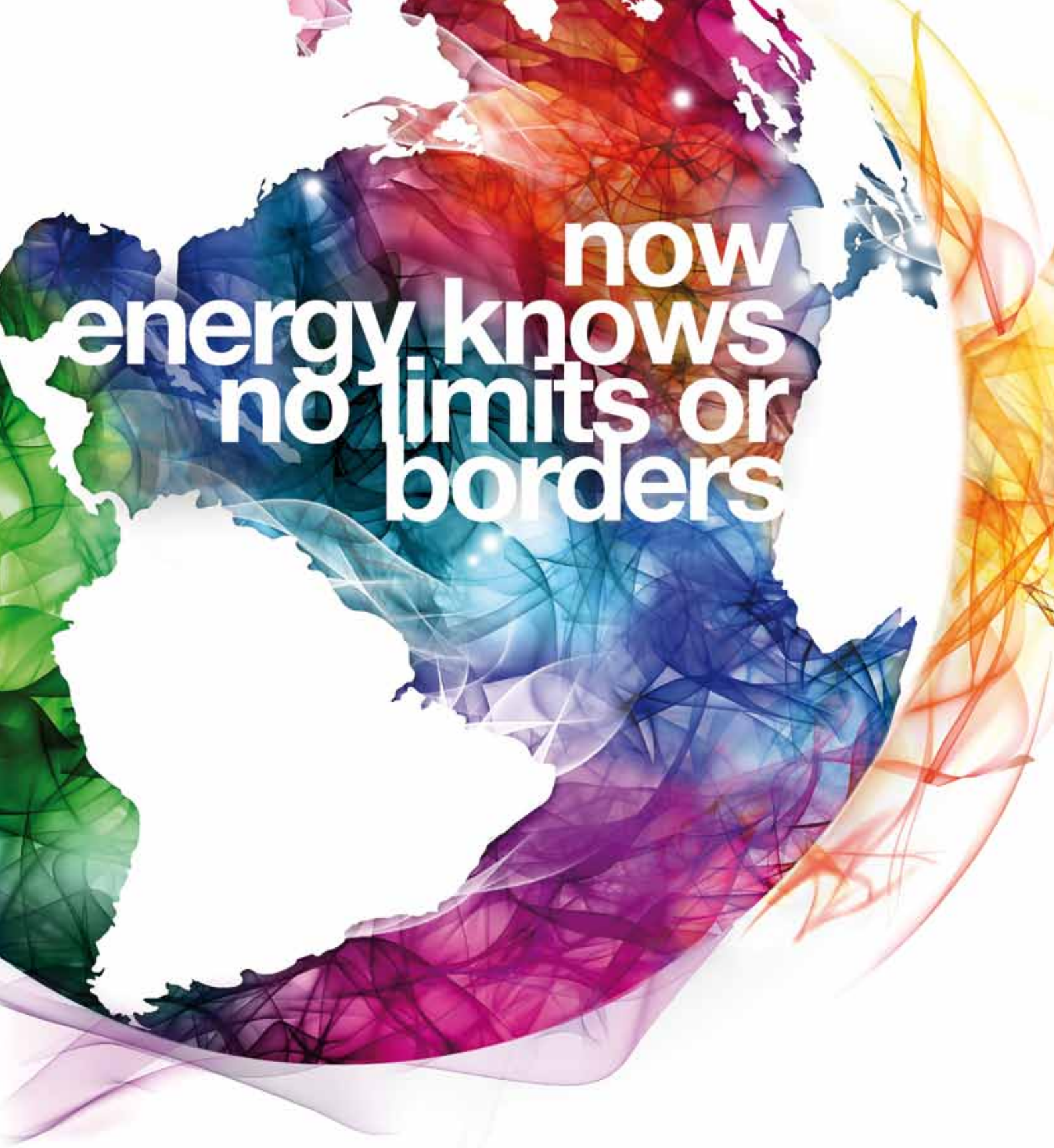
ENVIRONMENT Encourage and promote development of clean technology, renewable energy applications and other activities, which will add to the environmental benefits of gas;

INTERNATIONAL GAS TRADE Encourage international trade in gas by supporting non-discriminatory policies and sound contracting principles and practices;

LEGAL Promote and contribute to the development of legislation concerning:

- ◆ the establishment of equitable, non-discriminatory and reasonable environmental and energy efficiency regulations, and
- ◆ efforts to establish appropriate and relevant international standards, as well as
- ◆ the promotion of and participation in the exchange of information relating to regulatory processes;

COOPERATION Enhance partnership with industry and manufacturers, and cooperation with governments, policymakers and international energy related organisations, and promote the exchange of information among members in order to help them in improving the efficiency and safety of gas operations.



now energy knows no limits or borders

Two of the gas and electricity industry experts have joined forces to create the first seamlessly integrated energy company in Spain and Latin America. Now energy can adapt to your needs and to those of over twenty million clients in twenty three countries around the world. We have gone a long way together and we'll continue to work with all the energy in the world to stay by your side. Like to join us?

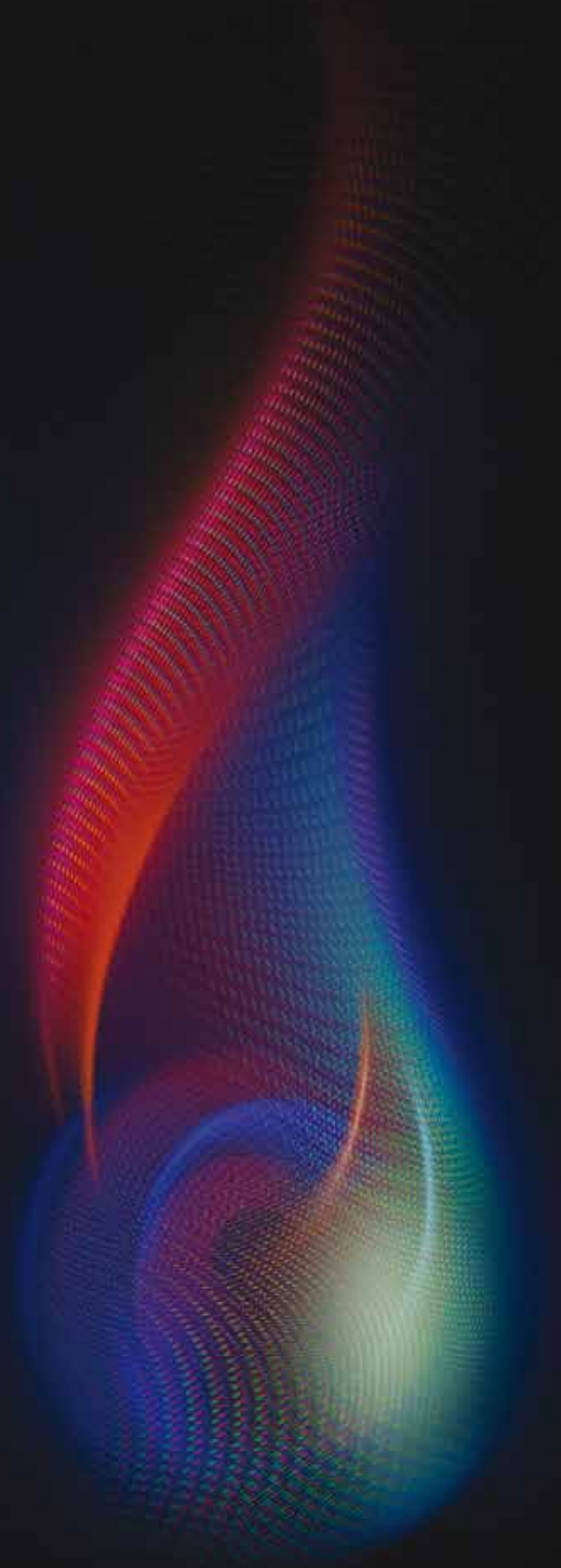
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Energy and economic growth for the world

Global energy demand is expected to be about 35 percent higher in the year 2040 than it was in 2010. Natural gas will continue to play an increasingly important role in meeting this growing demand, while at the same time helping power economic growth and improving living standards. A rising share of global natural gas demand will likely be met by unconventional gas supplies, such as those produced from shale and other rock formations. As one of the world's largest producers of natural gas, ExxonMobil is committed to developing this important resource. Because it's more than just a business opportunity ... it's an investment in the future.

ExxonMobil



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The opinions and views expressed by the authors in this magazine are not necessarily those of IGU, its members or the publisher. While every care has been taken in the preparation of this magazine, they are not responsible for the authors' opinions or for any inaccuracies in the articles.

Unless otherwise stated, the dollar (\$) values given in this magazine refer to the US dollar.

Bringing energy to life

**Qatar, 6:30 am. Abdulla's heritage is linked to his future.
RasGas is there.**

RasGas supplies Europe, Asia and the Americas with liquefied natural gas,
one of the world's most climate-friendly fossil fuels.
From Qatar, one of the world's largest and most reliable sources.



the power of the drop
THE ENERGY TO TRANSFORM

Message from the President

Dear Colleagues

During 2014 we have witnessed the consolidation of the trend that emerged in 2013, positioning natural gas as the fossil fuel of the future and the best suited to support the development of renewable energies. Global demand is rising, driven by growing demand from emerging countries, in particular in Asia and the Middle East. Initiatives under discussion in Africa, the Middle East and the eastern Mediterranean region will complement major projects currently under development in Australia, Russia and Central Asia.

► Jérôme Ferrier,
President.

The Ukrainian crisis, which has raised fears of interruptions of supplies to Europe, has once again highlighted that security of supply is a real issue for the long-term contracts binding buyers and suppliers in the interests of both parties. An increase in the number of gas pipelines to supply gas via different routes would naturally help to improve the situation by optimising supply while enhancing solidarity. Rather than hinting that it may reduce its dependence on Russian gas in the short term, Europe should focus on issuing encouraging signs to potential investors to prompt them to build new pipelines.

Energy growth in Europe is slow today due to a combination of energy efficiency and energy saving policies and the economic crisis. Demand for energy, and natural gas in particular, will increase if measures are at last taken to limit the use of coal, which generates large quantities of CO₂ emissions. As Europe will need gas from Russia, Azerbaijan, Turkmenistan and Iran, new gas pipelines will be built.



Progress

Over the past few months, IGU has made considerable progress towards achieving the objectives of the 2012-2015 Triennium.

The Gas Advocacy Task Force has fully redesigned IGU's website, which has been relaunched as the Global Gas Portal. It also regularly posts papers outlining IGU's position on issues that could have an impact on the image of gas. To sustain this effort, we must review the way our Union is funded and relevant proposals will be presented at the Council meeting in Berlin.

We have established good working relations with intergovernmental organisations and NGOs and are now providing support to the Sustainable Energy Access for All programme. This is a UN initiative that IGU is helping develop in Africa in partnership with the World Bank Group. We have also initiated new collaboration with the International Peace Institute on energy

issues, in particular concerning the role that natural gas can play to promote peace.

Our relationship with international organisations was further strengthened through the joint event held with UNESCO in December 2013 on the subject of Women in Engineering in Africa and the Arab States (see the last issue for a full report). We look forward to consolidating this relationship through the Youth Programme during WGC 2015.

In response to the growing interest and enthusiasm for natural gas everywhere in the world, I have been invited on a number of occasions in the past six months to deliver keynote speeches on behalf of IGU at national and international conferences organised by our members in Perth, Seoul, New Delhi, Beirut, Muscat, Madrid, Moscow, Cartagena and Lima. More are scheduled in the near future in Beijing, Copenhagen, Singapore, Hong Kong, Dallas and Mexico City.

Finally, the 26th WGC in Paris in June 2015 will give us the opportunity to showcase the confidence global industries place in natural gas as an energy of the future that can provide



◀ COP 21 will be held in Paris in 2015. Jérôme Ferrier met Christiana Figueres, Executive Secretary of the UNFCCC in Bonn in February.

solutions for fighting climate change. It will anticipate the COP 21 Summit that will be held six months later, also in Paris, and will mark a turning point in the introduction of global measures to protect the environment against global warming.



Jérôme Ferrier



◀ In April, Jérôme Ferrier addressed the opening plenary session of APPEA's 2014 Conference and Exhibition in Perth, Australia.

Conviction to share

Imagine if a long-term energy future
also depended on the discovery of
new oil and gas resources



Although oil and gas resources are still plentiful, to satisfy growing demand both now and in the future Total continues to make significant discoveries. Relentlessly seeking to increase the productivity of oil and gas field reserves, we innovate to exploit new sources of fossil fuel. But because oil and gas are precious, it will be vital to focus their usage in those areas where it is hardest to replace: in transportation and petrochemicals.

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Message from the Secretary General

Dear Reader

A farewell message

It has been a privilege and a great pleasure to have been the Secretary General of IGU since November 1, 2007, when I took over from Peter Storm, and IGU's headquarters were relocated from Denmark to Norway. On December 1 this year I will hand on the baton to Pål Rasmussen, who will hold the position as Secretary General of IGU until the Norwegian host period expires on November 1, 2016.

Quite a few changes have taken place during my term, both in the energy landscape and in IGU itself. The gas industry has become more global and is increasingly shaped by both national and global energy policies. The need for economic growth to create jobs and prosperity for people must be combined with

environmentally acceptable energy solutions, and we need global answers.

In the gas industry we are convinced that gas will be of increasing importance in solving the world's energy challenges, both in the short and the long term. Although many people beyond our ranks share this viewpoint, we still find that policymakers, environmental organisations and the public in general lack information and knowledge of gas as a safe and environmentally friendly energy carrier. As the organisation for the gas industry worldwide, we need to engage in international and indeed global fora that deal with wider energy policy issues.

The close cooperation between the Secretariat and the Presidency is vital for IGU in achieving its goals. I have collaborated with three presidents – the first from Argentina,

► Torstein Indrebø,
Secretary General.



Ernesto López Anadón, the second from Malaysia, Datuk Abdul Rahim Hashim and the third and current President from France, Jérôme Ferrier. It has been an honour to work with them and their highly professional teams. Together we have carried out important reforms during these presidencies and I would like to highlight a few of them:

- ◆ Strengthening the regional presence of IGU by appointing Regional Coordinators;
- ◆ Modernising the image of IGU with a new logo to facilitate promotion of the Union;
- ◆ Renewal of the publication strategy to increase the number and quality of IGU publications;
- ◆ Remodelling the format of the annual meetings with interactive workshops;
- ◆ Increasing the number of speaking engagements to actively promote natural gas towards various stakeholders;
- ◆ Higher visibility of IGU through various intermediate events before the WGC;
- ◆ Increased cooperation with other worldwide and regional organisations such as the IEA, EU, IEF, World Bank, UNIDO, UNESCO, UNECE, G20 Group and ASEAN;
- ◆ Increased dialogue with environmental organisations such as Greenpeace and others;
- ◆ Improved the financial capacity of IGU by introducing royalty payments for IGU conferences;
- ◆ Launch of several initiatives to improve IGU communication activities such as regular improvements of the IGU website, a newsletter, press and media events, and most recently the Global Voice for Gas project.

I believe these initiatives have made IGU a more robust and relevant organisation for our members and for the industry in general.

The flagship IGU events have grown in prominence and size bringing all key stakeholders together, sharing and discussing energy issues. We all look forward to the “Olympics of the gas industry”, WGC 2015, in Paris next year, but before that many of us will have met in

September in Copenhagen at IGRC 2014.

In April 2016, we will meet in Perth, Australia for LNG 18, the largest and most important LNG conference in the world.

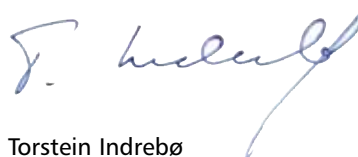
Access to a secure supply of energy is critical for any society and its economic and industrial development, as well as for people’s general wellbeing and standard of living. IGU is now working with the United Nations and the World Bank on the transfer of gas competence to developing countries to improve their access to energy services decisive for their development. Many of our new members are from countries that wish to increase the use of gas in their energy systems. IGU provides them with opportunities to learn more about this by gaining access to global best practice and experience.

It would not have been possible to increase our activities and expand our global presence without a highly qualified and dedicated team in the IGU Secretariat. The many talented and experienced secondees have been crucial to our extended outreach and have enhanced the competence base of IGU.

I have had the pleasure of working in an organisation with a positive and enthusiastic membership, and it has been great to welcome many new members from all over the world, now likely to exceed 130 after the Council meeting in Berlin.

I would like to take this opportunity to thank my colleagues and all IGU members for the support they have given me during my term as IGU Secretary General. I wish Pål and all of you the best of luck in your continuing efforts to make IGU the spokesperson for the gas industry worldwide.

Thank you!



Torstein Indrebø



Fifty years ago, Shell was proud to have been involved in the world's first commercial liquefaction plant in Algeria and the voyage of the first commercial liquefied natural gas (LNG) cargo. Now, Shell is at the forefront of the next first for the LNG industry: floating LNG (FLNG), which will allow gas to be liquefied at sea.

LEARN MORE ABOUT THE
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Press Notes

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Shell International Petroleum Co. Ltd.
Shell Centre, London, S.E.1, England.

1964
September 25, 1964



207. ALGERIA - Inauguration of CAMEL Plant at Arzew

President Ahmed Ben Bella of Algeria was on September 27 inaugurating at Arzew, Algeria the world's first commercial plant for the liquefaction and export of natural gas, built and owned by Compagnie Algerienne du Methane Liquide (CAMEL). This event will be shortly followed by the start of the United Kingdom Gas Council's Methane import scheme, and early next year methane from Arzew will also be imported by France.

The plant inauguration, followed by the arrival of the first commercial cargo of liquid natural gas in the U.K., will mark the birth of a new world industry.

HALF A CENTURY OF FIRSTS



2014



PRELUDE FLNG

Shell floats hull
for world's largest
floating facility

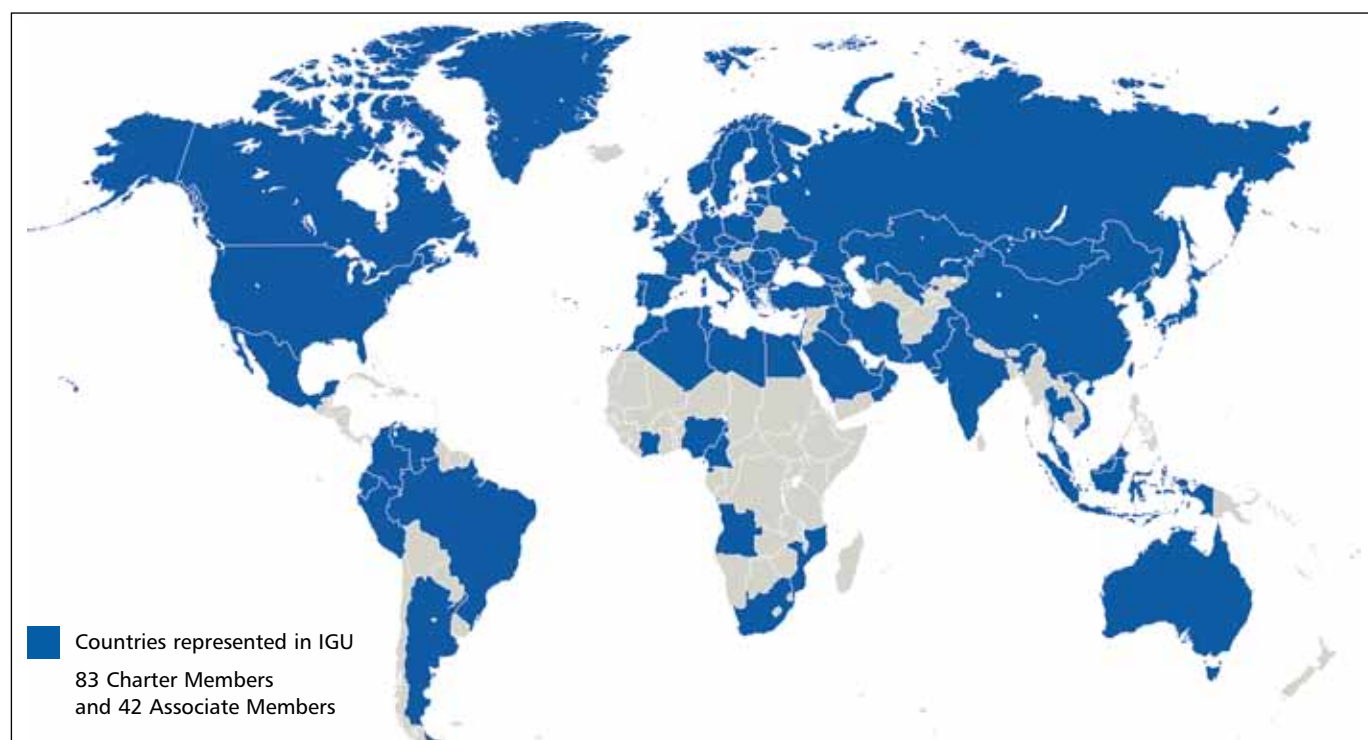


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MAKING FLNG
A REALITY**

**OPENING UP
NEW BUSINESS
OPPORTUNITIES**

Countries Represented in IGU

Albania	Denmark	Libya	Serbia
Algeria	Egypt	Lithuania	Singapore
Angola	Equatorial Guinea	Macedonia	Slovak Republic
Argentina	Estonia	Malaysia	Slovenia
Australia	Finland	Mexico	South Africa
Austria	France	Monaco	Spain
Azerbaijan	Germany	Mongolia	Sweden
Belgium	Greece	Morocco	Switzerland
Bosnia and Herzegovina	Hong Kong, China	Mozambique	Taiwan, China
Brazil	India	Netherlands, The	Thailand
Brunei	Indonesia	Nigeria	Timor-Leste
Bulgaria	Iran	Norway	Trinidad and Tobago
Cameroon	Iraq	Oman, Sultanate of	Tunisia
Canada	Ireland	Pakistan	Turkey
China, People's Republic of	Israel	Peru	Ukraine
Colombia	Italy	Poland	United Arab Emirates
Côte d'Ivoire	Japan	Portugal	United Kingdom
Croatia	Kazakhstan	Qatar	United States of America
Cyprus	Korea, Republic of	Romania	Uzbekistan
Czech Republic	Latvia	Russian Federation	Venezuela
	Lebanon	Saudi Arabia	Vietnam



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We produce gas ourselves so we understand the challenges faced by explorers and producers. In a complex and sophisticated market, we can deliver the solutions our customers are looking for.



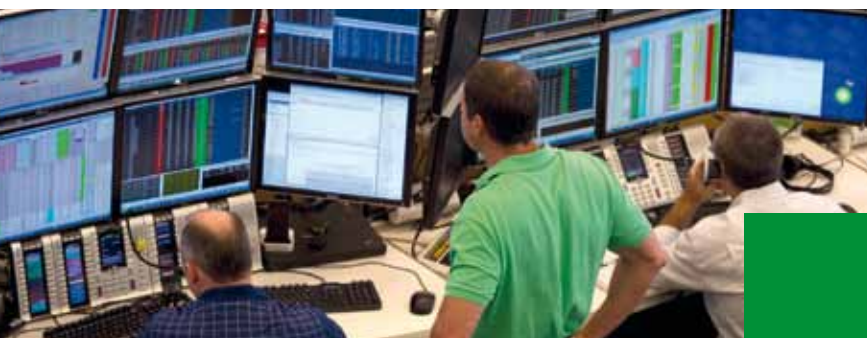
We are one of the world's leading international oil and gas companies. We provide fuel for transportation, energy for heat and light, retail services and petrochemicals products. Our activities include oil and natural gas exploration, field development and production, midstream transportation, storage and processing, and the marketing and trading of natural gas, including LNG, together with power and natural gas liquids.

Our size and global reach are important. But we believe that ultimately success comes from the energy of our people and the strength of the relationships we build.

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Paul Reed, CEO
BP Integrated
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Charter Members

Albania Albanian Energy Regulator (ERE)	Colombia Asociación Colombiana de Gas Natural – Naturgas	Iran National Iranian Gas Company (NIGC)	Morocco Fédération de l'Énergie de la Confédération Générale des Entreprises du Maroc (CGEM)	Serbia Gas Association of Serbia
Algeria Association Algérienne de l'Industrie du Gaz – AIG	Côte d'Ivoire PETROCI Holding – Société Nationale d'Opérations Pétrolières de la Côte d'Ivoire	Iraq Oil Marketing Company (SOMO)	Mozambique Empresa Nacional de Hidrocarbonetos, E.P. (ENH)	Singapore Power Gas Ltd
Angola Sonangol Gás Natural	Croatia Croatian Gas Association	Ireland Irish Gas Association – Bord Gais Eireann	Netherlands, The Royal Dutch Gas Association – Koninklijke Vereniging van Gasfabrikanten in Nederland (KVGn)	Slovak Republic Slovak Gas and Oil Association
Argentina Instituto Argentino del Petróleo y del Gas	Cyprus Ministry of Commerce, Industry & Tourism	Israel The Israeli Institute of Energy & Environment	Nigeria Nigerian Gas Association c/o Nigeria LNG Ltd	Slovenia Geoplin d.o.o. Ljubljana
Australia Australian Gas Industry Trust	Czech Republic Czech Gas Association	Italy Comitato Italiano Gas (CIG)	Norway Norwegian Petroleum Society (NPF) – Norwegian Gas Association	South Africa CEF (Pty) Ltd
Austria Österreichische Vereinigung für das Gas- und Wasserfach (ÖVGW)	Denmark Dansk Gas Forening – Danish Gas Association	Japan The Japan Gas Association	Oman, Sultanate of Oman LNG L.L.C.	Spain Spanish Gas Association – Asociación Española del Gas (SEDIGAS)
Azerbaijan State Oil Company of the Azerbaijan Republic (SOCAR)	Egypt Egyptian Gas Association	Kazakhstan KazTransGas JSC	Pakistan Petroleum Institute of Pakistan	Sweden Swedish Gas Association – Energigas Sverige
Belgium Association Royale des Gaziers Belges	Equatorial Guinea Sociedad Nacional de Gas G.E.	Korea, Republic of Korea Gas Union	Peru Perúpetro S.A.	Switzerland Schweizerische Aktiengesellschaft für Erdgas (SWISSGAS)
Bosnia and Herzegovina Gas Association of Bosnia and Herzegovina	Estonia Estonian Gas Association	Latvia JSC Latvijas Gāze	Poland Polskie Zrzeszenie Inżynierów i Techników Sanitarnych (PZITS) – Polish Gas Association	Taiwan, China The Gas Association of the Republic of China, Taipei
Brazil Associação Brasileira das Empresas Distribuidoras de Gás Canalizado (ABEGÁS)	Finland Finnish Gas Association	Lebanon Ministry of Energy and Water	Portugal Associação Portuguesa das Empresas de Gás Natural	Thailand PTT Public Company Ltd
Brunei Brunei Energy Association	France Association Française du Gaz (AFG)	Libya National Oil Corporation	Qatar Qatar Liquefied Gas Company Ltd (Qatargas)	Timor-Leste Timor Gás e Petróleo, E.P.
Bulgaria Overgas Inc.	Germany Deutscher Verein des Gas- und Wasserfaches e.V. (DVGW)	Lithuania Lithuanian Gas Association	Romania S.N.G.N. Romgaz S.A.	Trinidad and Tobago The National Gas Company of Trinidad and Tobago Ltd
Cameroon Société Nationale des Hydrocarbures	Greece Public Gas Corporation of Greece (DEPA) S.A.	Macedonia Macedonian Gas Association	Russian Federation OAO Gazprom	Tunisia Association Tunisienne du Pétrole et du Gaz (ATPG) c/o ETAP
Canada Canadian Gas Association	Hong Kong, China The Hong Kong & China Gas Co. Ltd	Malaysia Malaysian Gas Association (MGA)	Saudi Arabia Saudi Aramco	Turkey BOTAŞ
China, People's Republic of China Gas Society	India Gas Authority of India Ltd (GAIL)	Mexico Asociación Mexicana de Gas Natural, A.C.		Ukraine Naftogaz of Ukraine
	Indonesia Indonesian Gas Association (IGA)	Monaco Société Monégasque de l'Électricité et du Gaz (SMEG)		United Arab Emirates Abu Dhabi Liquefaction Company Ltd (ADGAS)
		Mongolia Baganuur Joint Stock Company		

2014 - 2015 International Bidding Rounds in Peru



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06 OFFSHORE
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Charter Members (continued)

<i>United Kingdom</i> The Institution of Gas Engineers and Managers	<i>United States of America</i> American Gas Association	<i>Uzbekistan</i> Uzbekneftegaz (UNG)	<i>Vietnam</i> Vietnam Oil and Gas Group (PetroVietnam)
		<i>Venezuela</i> Petróleos de Venezuela S.A. (PDVSA)	

Associate Members

Abu Dhabi National Oil Company (ADNOC) Distribution (UAE)	N.V. Nederlandse Gasunie (The Netherlands)
Australian Petroleum Production & Exploration Association – APPEA (Australia)	OMV Gas & Power GmbH (Austria)
BG Group plc (United Kingdom)	Origin Energy Limited (Australia)
BP Gas Marketing Ltd (United Kingdom)	Petróleo Brasileiro S.A. – Petrobras (Brazil)
Bursagaz (Turkey)	Petronet LNG Limited (India)
Cheniere Energy Inc. (USA)	RasGas Company Limited (Qatar)
Chevron Corp. (USA)	Repsol S.A. (Spain)
China National Petroleum Corporation (China)	Russian Gas Society (Russia)
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DNV GL (Norway)	Société Suisse de l'Industrie du Gaz et des Eaux – SSIGE/SGW (Switzerland)
E.ON Global Commodities SE (Germany)	Sonorgás (Portugal)
Eurogas	Spetsneftegaz NPO JSC (Russia)
ExxonMobil Gas & Power Marketing (USA)	TAQA Arabia (Egypt)
Gaslink – Gas System Operator Ltd (Ireland)	TBG – Transportadora Brasileira Gasoduto Bolívia-Brasil S.A. (Brazil)
GasTerra B.V. (The Netherlands)	TgP – Transportadora de Gas del Perú (Peru)
GAZBIR – Association of Natural Gas Distributors of Turkey	TOTAL S.A. (France)
GDF SUEZ (France)	Vopak LNG Holding B.V. (The Netherlands)
IGDAŞ – Istanbul Gas Distribution Co. (Turkey)	Westnetz GmbH (Germany)
Indian Oil Corporation Ltd (India)	Wintershall Holding GmbH (Germany)
INPEX Corporation (Japan)	Woodside (Australia)
Instituto Brasileiro de Petróleo, Gás e Biocombustíveis – IBP (Brazil)	
Liander N.V. (The Netherlands)	

Organisations Affiliated to IGU

Energy Delta Institute (EDI)	NGV Global
Gas Infrastructure Europe (GIE)	NGVA Europe – European Association for Bio/Natural Gas Vehicles
Gas Technology Institute (GTI)	International Pipe Line & Offshore Contractors Association (IPLOCA)
GERG – Groupe Européen de Recherches Gazières/European Gas Research Group	MARCOGAZ – Technical Association of the European Natural Gas Industry
GIIGNL – Groupe International des Importateurs de Gaz Naturel Liquéfié/International Group of LNG Importers	Pipeline Research Council International, Inc. (PRCI)
	Russian National Gas Vehicle Association (NGVRUS)



YEMEN LNG COMPANY

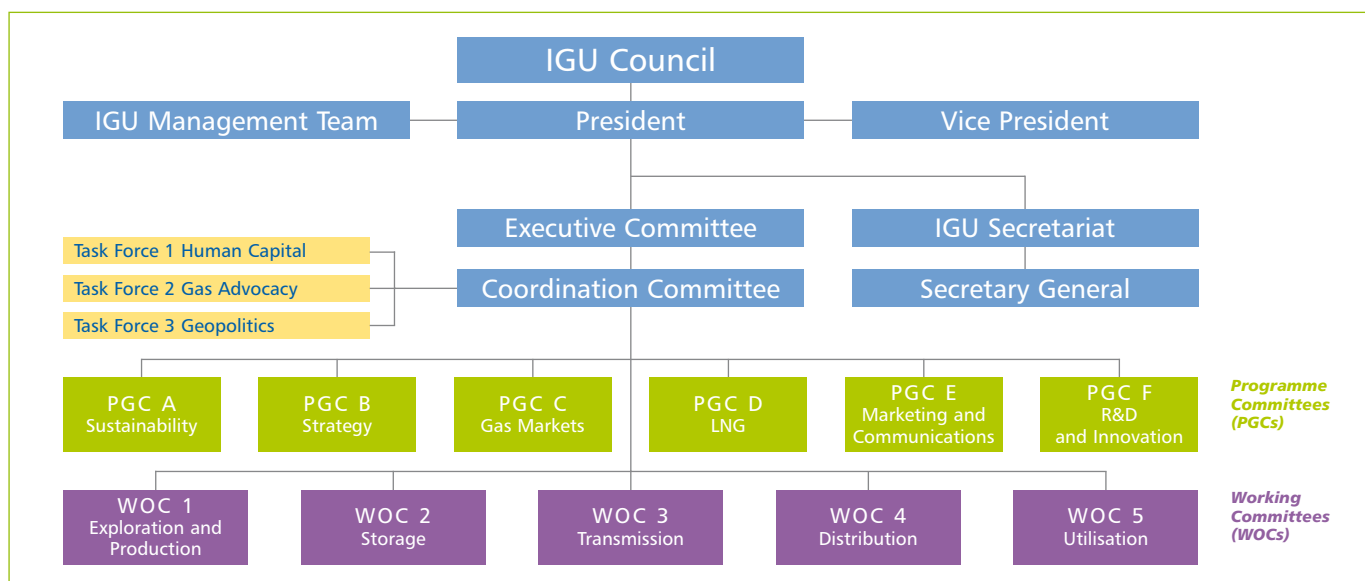
Delivering Energy To The World

By transporting LNG from Marib, the historic kingdom of the Queen of Sheba; to the Far East, the Middle East, Europe and the Americas, Yemen LNG keeps alive the ancient tradition of Yemeni merchants' caravans. Yemen LNG also contributes to the economic and social development of the people of Yemen.



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IGU Organisation 2012–2015



This photograph was taken at the Executive Committee (EXC) meeting which was held in Sydney, Australia, in April 2014.

From left to right in the front row are: Cynthia Silveira, Lixin Che, Javier Gremes Cordero, Valérie Ruiz-Domingo, Pavol Janočko, Torstein Indrebø (IGU Secretary General), David Carroll, Jérôme Ferrier, Datuk (Dr) Abdul Rahim Hj Hashim,

Robert Doets (who was substituting for Gertjan Lankhorst), Mel Ydreos and Antoni Peris Mingot.

From left to right in the back row are: Chris Gunner, Timothy M. Egan (behind), Runar Tjersland, Masazumi Hirono (behind, who was substituting for Kyoji Tomita), Jae-Seob Kim, Xia Yongjiang, Lori Traweek (who was substituting for David McCurdy), Kang-Soo

Choo, Paco Freens, Pål Rasmussen (IGU Deputy Secretary General), Georges Liens, Marcel Kramer, Cheryl Cartwright, Evgueni Riazantsev and Dietmar Spohn (who was substituting for Walter Thielen).

Khaled Abubakr, Bruno Armbrust, Jean Schweitzer and Abdelhamid Zerguine were absent.

IGU Management Team



Mr Jérôme Ferrier, President
(France)



Mr David Carroll, Vice President
(USA)



Datuk (Dr) Abdul Rahim Hj Hashim,
Immediate Past President
(Malaysia)



Mr Georges Liens, Chair of the
Coordination Committee (France)



Mr Mel Ydreos, Vice Chair
of the Coordination Committee
(Canada)



Mr Torstein Indrebø, Secretary
General

IGU Executive Committee

Mr Abdelhamid
Zerguine, Algeria

Mr Javier Gremes
Cordero, Argentina

Ms Cheryl Cartwright,
Australia

Mr Bruno Armbrust,
Brazil

Ms Lixin Che, China

Mr Timothy M. Egan,
Canada

Mr Mel Ydreos, Canada

Mr Jean Schweitzer,
Denmark

Mr Jérôme Ferrier,
France

Mr Georges Liens,
France

Mr Walter Thielen,
Germany

Mr Kyoji Tomita, Japan

Mr Jae-Seob Kim,
Republic of Korea

Datuk (Dr) Abdul Rahim
Hj Hashim, Malaysia

Mr Gertjan Lankhorst,
The Netherlands

Mr Runar Tjersland,
Norway

Mr Paco Freens, Qatar
Mr Evgueni Riazantsev,
Russia

Mr Pavol Janočko,
Slovak Republic

Mr Antoni Peris Mingot,
Spain

Mr David Carroll, United
States of America

Hon. David McCurdy,
United States of America

Mr Xia Yongjiang, China
National Petroleum
Corporation, Associate
Member

Ms Valérie Ruiz-
Domingo, GDF Suez,
Associate Member

Mr Chris Gunner, Shell,
Associate Member

Mr Khaled Abubakr,
TAQA Arabia, Associate
Member

Ms Cynthia Silveira,
Total, Associate Member

Kang-Soo Choo
IGU Regional
Coordinator for Asia
and Asia-Pacific

Marcel Kramer
IGU Regional
Coordinator for the
Russia-Black Sea-
Caspian area

News from the Presidency and Secretariat

The main activities of the IGU Presidency and Secretariat since the last issue of the IGU Magazine (April-September 2014) are detailed below in news items and general information.

Global Gas Portal

IGU has launched a redesigned website (www.igu.org) and the Global Gas Portal, a new online presence which is currently one of the Union's most important strategic projects.

We are at a vital moment in our industry. The future of the global energy mix is being fiercely debated right now in the corridors of power, and our voice – the “Global Voice of Gas” – needs to be heard. While many of us have hailed the arrival of the Golden Age of Gas, in reality it is still approaching the platform.

The launch of the Global Gas Portal sets us up to proactively advocate for increasing the role of gas in the current and future energy mix, and IGU has invested significant amounts to reach this point. However, this investment has stretched the Union's financial capacity and we recognise that a financially sustainable

model must be developed to ensure successful operation of the portal, something we hope to do between now and the Council meeting in Paris in June 2015. In the meantime, IGU has asked key industry players for sponsorship to continue to implement and refine the initiative “Raising the Global Voice of Gas”. Sponsorship will allow us to build on our recent success and advance our advocacy aspirations at this key moment in time and prior to establishing a more sustainable future funding model for IGU.

We strongly believe that the global gas industry needs to promote the benefits of natural gas in the global energy mix more proactively and effectively. The time for strong advocacy is now and we must seize the moment.

IGU Young Professionals Sponsorship Programme for IGRC2014

As this issue went to press, the IGU Research Conference 2014 was about to take place in Copenhagen, Denmark, September 17-19. IGU has sponsored 35 young professionals

► IGU has launched its new website and the Global Gas Portal.





◀ As this issue went to press, IGRC2014 was about to take place in Copenhagen.

to participate in IGRC2014. The sponsorship includes free conference registration, complimentary meals on site and a lump sum to cover the cost of accommodation in Copenhagen.

The call for applications was issued in December 2013 and there was strong international interest with more than 100 applicants. After having been reviewed for profile relevance by the PGC F screening group chaired by Jack Lewnard, the applications were sent to the Regional Coordinators, Secretariat and Presidency. The 35 sponsorship packages have been awarded to students and young professionals from 20 countries who will report back to their companies and universities after the conference.

There will be a full report on IGRC2014 in the next issue.

4th IEF-IGU Ministerial Gas Forum

The Mexican government will host the next edition of the biennial Forum co-organised by IGU and the International Energy Forum. It will take place in Acapulco on Wednesday,

November 12. Mexico's new energy policy will be one of the focal points for the discussions taking place this year under the theme "The Role of Gas in Energy Security and Sustainable Economic Development". There is strong interest in the Forum from industry representatives and government officials.

The earlier editions of the Forum were held in Vienna (2008), Doha (2010) and Paris (2012).

▼ Delphine Batho, then French Minister of Ecology, Sustainable Development & Energy at the 3rd IEF-IGU Ministerial Gas Forum with Jérôme Ferrier and Torstein Indrebø.



▼ Jérôme Ferrier and Torstein Indrebø with Rachel Kyte, the World Bank Group's Vice President and Special Envoy for Climate Change, after one of the regular meetings between IGU and the World Bank.



▼ Torstein Indrebø in Hanoi with Pham Tien Dung, President and CEO of PV Drilling, one of PetroVietnam's subsidiaries.

IGU contribution to UN Sustainable Energy for All initiative

Following the successful gas training seminar in Abidjan, Côte d'Ivoire, November 4-5, 2013, which was covered in the last issue, IGU has

further strengthened its cooperation with the UN and World Bank. The aim is to contribute to the Sustainable Energy for All initiative by enhancing access to sustainable energy and economic development with gas.

In that context, IGU and the World Bank are in continuing discussions regarding the necessary steps in developing countries, particularly in sub-Saharan Africa where the initial focus for the joint activities lies. Having held the seminar in West Africa in 2013, IGU and the World Bank are now looking at East Africa where both Tanzania and Mozambique have announced major gas discoveries which could foster further development in the region.

Visit to Vietnam

IGU was invited to join a high-level Norwegian oil and gas delegation to Hanoi, Vietnam, which was led by HRH Crown Prince Haakon Magnus. During the visit, which took place on February 19-20, Torstein Indrebø met representatives of the country's Charter Member, PetroVietnam. He gave a presentation on IGU's recent activities and encouraged our Vietnamese colleagues to participate in the Union's technical committees.

Meeting with Australian government representatives

On Monday, March 31, Jérôme Ferrier, Torstein Indrebø and Cheryl Cartwright, Director of Australian Gas Industry Trust, had a courtesy meeting with the Hon. Ian Macfarlane, Minister of Industry and Martin Hoffman, Deputy Secretary, Department of Industry, in Brisbane. The discussion included topics such as Asian gas market developments, Australia's role as a major gas supplier and IGU's involvement in the G20's Energy Sustainability Working Group.

CC and EXC meetings in Sydney

Australia hosted the first 2014 meetings of the Coordination and Executive Committees in Sydney, April 1-4, and the event generated





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► Jérôme Ferrier at the 2014 Congress of Naturgas in Cartagena de Indias.



extensive press coverage. A full report can be found on pages 40-42.

APPEA 2014 conference

Jérôme Ferrier gave a speech on “Natural Gas: an integral part of a sustainable global energy future” at the 2014 conference and exhibition

of the Australian Petroleum Production & Exploration Association (APPEA), which was held in Perth, April 6-9. He also held a press conference and gave an interview to CNBC. This important event gathered more than 5,000 delegates, with a strong presence from policymakers.

Environmental congress in Bulgaria

Sjur Bøyum, Communication Manager, represented IGU at the Fifth International Congress “Environmental and Energy Principles of Sustainable Development” held on April 8 in Sofia, Bulgaria. The Congress was arranged by Overgas, the IGU Charter Member for Bulgaria.

Naturgas 2014

Jérôme Ferrier attended the 17th Annual Congress of Naturgas, the Colombian Association of Natural Gas, in Cartagena de Indias, April 8-11. He delivered a closing speech in the presence of Colombia’s Secretary of Energy



and also held a post-session press conference. Colombia has seen a dramatic increase in natural gas production in recent years after the implementation of a series of regulatory reforms. Naturgas joined IGU in 2013 as the Charter Member for Colombia and will host the October 2015 Council meeting.

OGU 2014 – Uzbekistan Oil and Gas

The Deputy Secretary General, Pål Rasmussen attended the 18th Uzbekistan International Oil and Gas Exhibition and Conference in Tashkent on May 13-15 following an invitation received from the CEO of Uzbekneftegaz, Shokir Fayzullaev.

The main purpose was to represent IGU as keynote speaker at OGU 2014, and to hold separate meetings with key players from the local gas industry and discuss the possibility of Uzbekneftegaz helping to attract new IGU members from Central Asia.

14th IEF Ministerial Meeting

Jérôme Ferrier, Torstein Indrebø and Ksenia Gladkova, Senior Advisor, attended the 14th IEF Ministerial Meeting in Moscow on May 15-16. Russia's Prime Minister Dmitry Medvedev welcomed ministers, CEOs and officials from more than 100 delegations to discuss "The New Geography of Energy and the Future of Global Energy Security". Jérôme Ferrier delivered a keynote speech during Panel Session 2 entitled "Unconventional Oil and Gas: outlook, risks and potential", which concentrated on natural gas as a destination fuel for a sustainable low-carbon global economy. IGU's background paper on "Unconventional Gas: From Perplexity to Confidence. Concerns versus Facts" was distributed during the event.

Indonesian delegation visits Secretariat

A delegation from Pertamina, Indonesia, led by Hari Karyuliarto, Gas Director, and Yenni Andayani, Senior Vice President Gas &



◀ LEFT AND OPPOSITE BELOW
Pål Rasmussen represented IGU at OGU 2014 in Tashkent.



▼ IEF's Secretary General, Aldo Flores-Quiroga flanked by Jérôme Ferrier and Torstein Indrebø at the 14th IEF Ministerial Meeting in Moscow.

► From left to right during the Indonesian visit to the IGU Secretariat are: Pål Rasmussen, Hari Karyulianto, Pertamina's Gas Director, Torstein Indrebø, Saleh Iskak, Executive Secretary of the Indonesian Gas Society, Yenni Andayani, Pertamina's Senior Vice President Gas & Power and Carolin Oebel.



Power, visited the IGU Secretariat in Oslo, Norway, on May 21. The parties exchanged information about IGU activities and developments, and further discussed Indonesia's participation in and contribution to the IGU technical committees. Pertamina confirmed its interest in becoming an Associate Member of IGU.

Sedigas annual meeting

The Spanish Gas Association (Sedigas) held its annual meeting in Madrid, May 27-28, under the theme "Gas, Growth Opportunity" to

► Jérôme Ferrier delivering the closing speech at the Sedigas annual meeting in Madrid in May.



discuss the latest trends in the national and global gas business. The event was attended by Spain's Minister of Industry, Energy and Tourism, José Manuel Soria. Jérôme Ferrier delivered the closing speech giving a current overview of the global gas industry.

G20 Energy Sustainability Working Group

The second meeting of the Energy Sustainability Working Group (ESWG) under the Australian G20 Presidency took place in Sydney, May 28-30. As one of the invited international organisations, IGU was represented by Senior Advisor Mats Fredriksson. The meetings included a one-day workshop on energy infrastructure investments followed by a two-day meeting with participation from the G20 member countries and invited international organisations. IGU participated in the discussions and delivered two reports to the G20 group: on energy infrastructure investment for the workshop and on gas market security and resilience.

The ESWG decided to continue work on strengthening the gas market dialogue between the G20 countries. It was also agreed that the international organisations,

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*A barrel of oil equivalent (or "boe") is a unit of measurement used to compare the energy value of (non-liquefied) gas to that of crude oil.

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► Delegates to the G20 Energy Sustainability Working Group meeting in Sydney pose for a group photo.



▼ Jérôme Ferrier at the 21st WPC in Moscow with Kevin Ramnarine, Trinidad and Tobago's Minister of Energy (*far left*), Seyed Mohammad Hossein Adeli, GECF Secretary General (*second left*) and Adi Karev, Deloitte's Global Head of Oil & Gas, who moderated the WPC-IGU Gas Forum (*right*).

including IGU, should have an important role in those meetings.

Marcogaz workshop

IGU was invited by Marcogaz to participate in a workshop on new developments following the affiliated organisation's General Assembly in Prague, Czech Republic, on June 4. Khadija

Al-Siyabi, Advisor to the Secretary General, participated and gave a presentation on IGU's current activities including strategic projects, forthcoming meetings and the elections. Presentations were also given by representatives of the Czech Gas Association, Germany's DVGW, Chart Ferox, Switzerland's SVGW, Eurogas, GERG and GIE.



21st World Petroleum Congress

IGU sent a high-level delegation to the 21st World Petroleum Congress (WPC), which was held in Moscow, Russia, June 16-19. The delegation was led by the President, Jérôme Ferrier, who spoke at the WPC-IGU Gas Forum about the role of LNG in an unconventional world. His fellow panellists included Kevin Ramnarine, Trinidad and Tobago's Minister of Energy, and Seyed Mohammad Hossein Adeli, Secretary General of the Gas Exporting Countries Forum (GECF).

IGU had a stand in the exhibition to promote IGRC2014, WGC 2015 and LNG 18. Torstein Indrebø and Daniel Paccoud, Chair of the National Organising Committee for WGC 2015 met with many IGU members and other delegates in Moscow.



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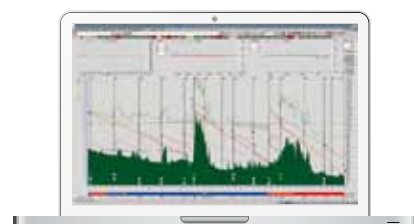
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▲ Torstein Indrebø addresses the Indonesian Energy Forum.

Indonesian Energy Forum

Torstein Indrebø attended the Indonesian Energy Forum, which was held in Jakarta, June 25-26, and gave a keynote address on “Trends and Perspectives of the Global Gas Industry”. He also took the opportunity to meet Hendi Prio Santoso, Chairman of the Indonesian Gas Association, the country’s IGU Charter Member.

▶ Torstein Indrebø with Myanmar’s Deputy Minister of Energy, HE U Aung Htoo (right) and the Planning Director of MOGE, U Than Minn (left).

Visit to Myanmar

The Secretary General, Torstein Indrebø visited Myanmar in July to discuss the country’s possible membership of IGU. Myanmar is already a significant gas producer and exports gas to Thailand and China. On July 1, he had a meeting in Nay Pyi Taw, the capital of Myanmar, with the Deputy Minister of Energy, HE U Aung Htoo and the Planning Director of Myanmar Oil & Gas Enterprise (MOGE), U Than Minn. They expressed interest in IGU’s activities and in joining the Union.

Seconded vacancy

IGU has a seconded vacancy offering the opportunity for members to second a person with some years of experience in the field

of energy to the IGU Secretariat in Oslo. The position will expose the candidate to a wide area of responsibilities and give them experience of a unique international environment. IGU will cover the candidate’s job-related expenses, including travel costs, while the employer of the secondee must cover salary and other costs related to the assignment. The secondment period is normally for two years and all members are invited to contact the Secretariat to find out more.

Carolyn Oebel, Director, and Ksenia Gladkova, Senior Advisor to the Secretary General, are nearing the end of their secondments from E.ON and Total respectively. Carolyn’s farewell message is on page 38 and Ksenia will write one for the next issue.



A Brief Introduction to China's Gas Industry

Since the beginning of the 21st century, with pipeline projects such as the West-to-East Gas Transmission Project and Sichuan-East Gas Transmission Project being put into operation, the natural gas industry in China has witnessed major development. A multiple gas resource supply pattern is taking shape and gas transmission and distribution systems enjoy rapid progress, contributing to a more secure and steady gas supply and greater diversification in gas applications. Gas consumption volumes have increased sharply – annual gas consumption in China has reached 167.6 billion cubic metres (bcm), accounting for 5.8% of primary energy consumption. Domestic output amounts to 117 bcm; while import volumes have reached 53 bcm, making the foreign dependency ratio 32%. The total length of gas transmission trunk line now exceeds 60,000 km. More than three million people working in over 2,000 gas companies in the upstream, midstream and downstream gas industries in China, provide services to over 240 million gas users.

Economic progress and growth in urbanisation in China have fuelled energy demand, and at the same time placed enormous pressure on the environment. In order to treat air pollution and improve citizens' quality of life, the Chinese government has highlighted enhancing ecological civilisation and building Beautiful China by focussing on green energy and low-carbon economic development. Natural gas has been identified as an important clean energy solution in these endeavours. It is estimated that by the years 2015 and 2020, gas supply volumes in China will reach 260 bcm and 400 bcm, accounting for more than 8% and 10% of primary energy consumption respectively.

With huge market potential, the gas industry in China is entering a stage of all-round development. In the next five years, natural gas demand will maintain an annual growth rate above 10%. To meet such surging demand, China will accelerate conventional and unconventional domestic gas exploration. And, based on self-sufficiency, China will further enhance resource introduction. Meanwhile, infrastructure will be expanded and new technology introduced at an accelerated rate to meet the rapid development in demand. On average an estimated 5,000 km of new gas pipeline will be constructed each year and new technologies will be brought in from overseas to further improve energy efficiency.

The world's energy industries are experiencing major transformation. As a clean, high quality, highly efficient energy resource, natural gas is playing an increasingly important role in forming a secure, stable, economic and clean energy mix for the future. The gas industry in China is also entering a stage of deepening reform and sustained development and it will be integrated into the world gas family in an open manner. We look forward to strengthened communication and cooperation with gas colleagues around the world regarding policies, resources, R&D, technology and security and to sharing with you China's development opportunities.





Carolin Oebel:
four exciting and very
rewarding years with IGU.

Carolin says “auf Wiedersehen”

That means not only “Goodbye” but also “I look forward to seeing you again” – and the latter meaning is the one I would like to emphasise.

After four exciting and very rewarding years with IGU my secondment from E.ON is coming to an end. For that reason, please allow me to give you a short recap of my time with IGU.

I started in the IGU Secretariat in September 2010 in the midst of the Malaysian triennium, a time when a lot of crucial questions were addressed, including the launching of the important and well-cited report *Global Vision for Gas – The Pathway towards a Sustainable Energy Future*.

It was certainly a big and exciting highlight to have been part of the successful 25th World Gas Conference in Kuala Lumpur, which was so well organised by the Malaysian Presidency. And I very much enjoyed working with the Malaysian team.

During those first two years with IGU I was involved in a lot of interesting tasks, mainly related to gas advocacy with the launching of *Facts & Figures about Gas*, the start of the European initiative GasNaturally and the IGU engagement in relation to the role of gas in the climate change mitigation process. In this context, I had the opportunity to represent IGU at international conferences and events to present the positive role that gas has and can bring to the table in the global energy system.

From January 2013 my tasks became even more exciting with the start of my role as Director, which allowed me to dive even deeper into the fascinating world of gas and its important questions. One of those important questions was how to contribute to economic development with gas in countries that are still lacking the right infrastructure but have recently found gas resources. To tackle this issue, IGU has established a close relationship and cooperation with the UN-World Bank

initiative “Sustainable Energy for All” which is headed by the UN Secretary General’s Special Representative, Dr Kandeh Yumkella, who is also one of the IGU Wise Persons.

IGU is a truly international organisation, and I am very pleased that I had the chance to work with IGU members from all around the world. But I was particularly glad that France held the Presidency for part of my time in the IGU Secretariat, not only due to the pleasant cooperation, but also as this allowed me to practise my French a bit more often. And I regret not being able to stay with the IGU Secretariat until the 26th World Gas Conference in Paris in 2015 to be part of the team at this important event for which the preparations are well underway.

I was also pleased in having had the chance to see the start of the enthusiastic work of the incoming American Presidency who will certainly do an excellent job during the next triennium.

But now I would like to thank the current French Presidency, the previous Malaysian Presidency, the American team and everyone else from the IGU community with whom I have had the pleasure of working.

I would also like to thank E.ON and all my E.ON colleagues who were involved in my secondment for making this unique international experience possible for me.

I especially want to thank Torstein Indrebø, the IGU Secretary General, and everyone from the IGU Secretariat with whom I have worked so closely over the last couple of years. I have had a very good time and I highly appreciate the great learning and development experience that the IGU Secretariat has provided me with. – I also want to thank everyone from the Norwegian team who patiently listened to my first attempts at speaking Norwegian. If they had not been that patient in the beginning, I would certainly not have come as far as I have.

Therefore I say both thanks a lot or “tusen takk” and “auf Wiedersehen”!



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Sydney Meetings Map Way Forward

By Ksenia Gladkova

Australia hosted IGU's bi-annual Executive Committee (EXC) and Coordination Committee (CC) meetings for the first time on April 1-4. The meetings took place in Sydney, New South Wales at the Four Seasons Hotel. They were attended by 63 delegates and 24 guests and accompanying persons.

With the increasing demand for energy worldwide and vast reserves of natural gas, Australia is increasing its LNG production and expects to become the world's leading LNG exporter by the end of the decade. On the domestic front, the country's size and low population density provide unique challenges for the economic transportation and distribution of natural gas.

Australia's gas industry has developed rapidly in recent times, from offshore developments, expanded pipeline networks and new LNG

projects to the reinvigoration of historic provinces such as the Cooper Basin. There are some \$200 billion worth of gas projects under development or being commissioned – and Australia is well positioned to service expanding energy consumption in south-east Asia.

The country's Charter Member is the Australian Gas Industry Trust which is administered by the Australian Pipeline Industry Association (APIA). Cheryl Cartwright is the CEO of APIA and a member of the EXC. Associate Members the Australian Petroleum Production & Exploration Association (APPEA) and Origin Energy also helped to organise the meetings.

Energy policy

The EXC meeting agenda included a discussion of IGU's objectives and strategies to 2020, in particular IGU involvement in global energy

► Australia is developing several major LNG projects around the country. On Curtis Island in Queensland, for example, three liquefaction plants with a combined capacity of 25.3 mtpa are under construction.



policy discussions. The Secretary General, Torstein Indrebø reported on IGU's participation in the G20 Energy Sustainability Working Group meeting in Melbourne, Australia, February 10-13. IGU succeeded in raising awareness of the important contributions that gas can provide with regard to both secure and sustainable provision of energy, as well as to economic development.

IGU has continued to participate in the G20 energy meetings under the Australian G20 Presidency (in Sydney in May and Brisbane in August), and will do so under the Turkish G20 Presidency in 2015 to maintain the Union's position as spokesperson for the gas industry in that arena.

Cooperation with the World Bank and relevant UN bodies regarding the transfer of gas competence for access to energy and economic development will be enhanced. The focus on human resources issues, in cooperation with UNESCO, will be continued.

Global Voice for Gas

The CC Vice Chair, Mel Ydreos submitted a report on the Global Voice for Gas initiative to the EXC for discussion and approval. He recommended a strategic and phased approach

towards greater and more effective gas advocacy, and emphasised the importance of interaction with the political sphere.

"The impetus for policymakers to act and create policies in support for natural gas is now, on all fronts," declared Mr Ydreos. "Despite the challenges, as an industry we have to join together to advocate and convince policy-makers that the road to economic recovery and sustainability, supporting environmental protection, dealing with climate change, addressing the concerns over nuclear that have come to the forefront with Fukushima, all can now be achieved with natural gas friendly policies."

Since the previous EXC meeting in Beijing in October 2013, work has been progressing on the creation of a Global Gas Portal to support the strategy of more effective advocacy. The Gas Portal will help raise the profile of gas and IGU globally.

A governance structure to guide the project has been set up. This includes the establishment of an Executive Strategic Committee and a Working Committee made up of members of PGC E, the Task Force on Advocacy, the Secretariat and the French Presidency.



▲ Mel Ydreos reports on the Global Voice for Gas initiative.

▼ Torstein Indrebø addresses delegates during the meetings in Sydney.





▲ Bob Baldwin, Parliamentary Secretary to Australia's Minister for Industry, addresses the farewell dinner.

A beta-working version of the new Portal was presented in Sydney and the new portal was launched in May.

Phase 2 of the plan involves the design and execution of a six-month outreach strategy, which will test out the ability to attract the targeted key audience to the Global Portal and assess their level of engagement. Concurrently, the Global Gas Portal will be further enhanced and developed.

Workshop

Traditionally, workshops are held during the EXC/CC meetings and this time the topic for the executive workshop was "The Role of Gas and IGU in Global Energy Politics". It opened with a two-hour special session on the latest developments in the Australian gas industry featuring speeches from Grant King, CEO of Origin Energy, David Byers, CEO of the Australian Petroleum Production & Exploration Association (APPEA) and Cheryl Cartwright.

The President, Jérôme Ferrier opened the main session dedicated to IGU's involvement in global energy policy. High-level speakers included Martin Hoffman, Deputy Secretary of Australia's Department of Industry and Chair of the G20 Energy Sustainability Working Group, who highlighted the importance of having the gas industry voice in the energy security discussions organised by G20.

Ian Cronshaw, Head, Gas, Coal and Power Markets at the IEA, presented an insight from

the *World Energy Outlook* highlighting gas supply/demand forecasts for 2020 and the prospects for a more interconnected global gas market through LNG expansion.

Professor Xiaojie Xu from the Chinese Academy of Social Sciences presented an outlook for energy demand in China and the importance of gas substituting coal in the country's power generation.

Alan Oxley, from the Australian Asia-Pacific Economic Cooperation (APEC) Study Centre, spoke on expanding the role of gas in APEC's energy mix.

Regional Coordinators

The EXC agreed to split the Regional Coordinator role for the Americas into two positions and delegates welcomed new coordinators for North America – Timothy Egan, CEO of the Canadian Gas Association – and for Latin America and the Caribbean – Cynthia Silveira, Total Director for Brazil. They have contributed short reports to this issue (see pages 44-45).

Strong media interest

There was strong interest from national print media and TV in the IGU meetings in Sydney. A notable highlight was an extensive interview given by Jérôme Ferrier and Grant King to the main national TV network ABC.

IGU officials also held a press conference to speak about recent developments and the prospects for gas markets in Australia and south-east Asia. Post-event coverage included articles in major national newspapers such as *The Australian* and *Financial Review*.

The IGU meetings in Sydney concluded with a farewell dinner featuring presentations from Jérôme Ferrier, Torstein Indrebø, Grant King and Bob Baldwin, Parliamentary Secretary to Australia's Minister for Industry.

Ksenia Gladkova is Senior Advisor to the Secretary General.

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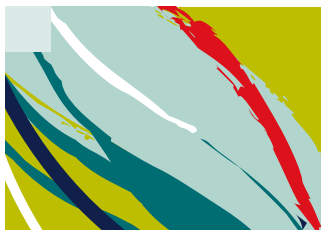
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New Regional Coordinators Appointed



Timothy Egan.

Following a decision by the Executive Committee in April and the resignation of Luis Domenech, IGU has divided the Regional Coordinator role for the Americas into two positions. We asked the newly appointed Regional Coordinators for North America, Timothy Egan, and South America and the Caribbean, Cynthia Silveira, to brief readers on the issues they will be addressing.

North America

A statement by Timothy Egan

All have observed how the last decade has delivered dramatic changes in the North American natural gas market. Our product has changed in status from “depleting resource” to “abundant asset”, from “transition fuel” to “foundation for our energy future”, from one of many increasingly costly energy sources to the one affordable fuel for economic growth.

That’s the good news. There are several bits of bad news as well though. First, approvals for building pipeline infrastructure are really, really difficult in many parts of North America, and becoming more difficult. Second, much of the new-found supply comes from gas produced thanks to the technological innovations around hydraulic fracturing – and the environmental impact of the extraction process remains very contentious in several markets. Third, the energy policy discourse is often dominated by electricity, and getting people to realise the opportunity afforded by the parallel energy delivery system that is natural gas infrastructure remains an ongoing challenge.

In the midst of all of this, IGU has created a Regional Coordinator role for North America. The timing is good. It gives IGU a chance to

think about this dynamic marketplace as a whole in the context of the global agenda. North America is poised to become a significant LNG supplier to global markets. How will it continue to consume LNG from those markets? There is also a willingness to export shale extraction know-how to other parts of the world that have shale resources. Will it be exported from the region in a significant way? Another critical issue that has some level of uncertainty is the possible impact of North American LNG prices on the global market. And a final big question: what role will a more bullish gas industry play in the continental energy-environment debate, and how will that affect the global discussion? These are some of the questions I think we should be discussing a lot more, and the new role gives me the opportunity to bring that discussion forward.

But I also see the position as a kind of ambassadorship for IGU and gas advocacy. Already, I have been in meetings with officials and industry players from all three countries in the region discussing how to make gas a bigger part of the continental energy conversation that occurs under NAFTA. Building gas into that conversation is important for our industry as we look to a stronger role for gas in the energy mix. IGU’s heightened advocacy – particularly its Global Portal for Gas – will help with such efforts, and I intend to use such IGU resources in my efforts.

I welcome any thoughts and suggestions for the new role, and look forward to working with my IGU colleagues on it going forward.

Timothy M. Egan is the President & CEO of the Canadian Gas Association (www.cga.ca).

South America and the Caribbean

A Q&A with Cynthia Silveira

What do you see as the major challenges facing the gas industry in your region?

The gas industry in South America and the Caribbean has a wide range of opportunities and challenges which vary according to the characteristics of each national market.

The gas industry has different levels of maturity and importance in each country, gas resources are not available everywhere, LNG exporters and importers do not necessarily develop long-term commercial relationships, and gas prices are high compared to our neighbouring region of North America except in those countries where they are controlled.

There are gas exporters and importers in Central and South America but the region as a whole is currently a net exporter of gas. Providing that countries are able to develop their reserves and overcome political issues, reserves already discovered could supply more than 40 years of 2013's production level. Given that some countries of the region import LNG in the spot market to meet growing demand, the major challenges facing the gas industry in the region are to enhance integration, to attract private investors and human resources to develop the reserves, and to build natural gas infrastructure, transportation and LNG terminals. Technology development will also play a key role to improve the development of the Argentine shale gas and Brazilian pre-salt reserves.

Motivated by these opportunities and challenges, Brazil will host the next IGU Research Conference – IGRC 2017 – in Rio de Janeiro. This will be organised by the Brazilian Institute of Petroleum, Gas and Biofuels (IBP), which is an Associate Member of IGU and is looking forward to the support of petroleum companies, the cooperation of universities and contributions from research centres in other countries of the region. Organising this event will be an excellent opportunity to reinforce

IGU's presence in South America and Caribbean and enhance the visibility of its work.

What are your aims as Regional Coordinator?

As a Regional Coordinator I seek to be of benefit to the IGU Executive Committee, helping its members to better understand the requirements and the challenges of this vast region, highlighting the transformations involving the industry and providing a follow-up on the future direction of the gas market in the region. Counting on the support of Charter and Associate Members, I will coordinate actions to make IGU's work more visible, engage with gas industry stakeholders, disseminate IGU's information and help IGU to be recognised as the voice for the gas industry worldwide.

How do you plan to achieve them?

I will inform members about IGU's work, participate in the seminars and congresses to which IGU is invited around the region and reinforce the Union's network, with the aim of having an open door and being available to help professionals have access to IGU information.

How do you see IGU membership expanding in your region?

IGU already has a broad presence in the region but we still miss some countries as members such as: Bolivia, Chile, Ecuador, Paraguay, Uruguay and Suriname. Using IBP's good relationship with Arpel (the Regional Association of Oil, Gas and Biofuels Sector Companies in Latin America and the Caribbean) and other bodies, I hope to be able to show these countries the importance of joining IGU and the benefits they can achieve through the knowledge that IGU promotes.

Cynthia Silveira is Gas & Power Director at Total Gás & Eletricidade do Brasil and a director of IBP (www.ibp.org.br).



Cynthia Silveira.

News from Organisations Affiliated to IGU

Here we have a joint report from the European Gas Research Group (GERG) and Marcogaz – The Technical Association of the European Gas Industry, followed by individual reports from the Energy Delta Institute (EDI), Gas Technology Institute (GTI), NGV Global, NGVA Europe and Pipeline Research Council International (PRCI).

GERG – Marcogaz Sensor Workshop

By Daniel Hec, Robert Judd and Jean Schweitzer

On February 27, GERG and Marcogaz jointly organised a workshop in Brussels on the subject of sensors in the gas industry, with a specific focus on gas quality sensing, measurement and control. The event was a great success with more than 60 participants from a broad range of industrial and academic bodies.

Context

The need to improve the security of Europe's gas supply has turned the spotlight on gas sensors. With new gases reaching the market – more LNG, hydrogen mixed in natural gas and biogas – sensor technology can help to manage technical challenges such as a wider Wobbe range.

Some sensors are already on the market for certain applications, while others are in the development phase. We face a transient situation where the involved stakeholders are not necessarily aware of the current status of sensor technology.

On one hand, gas industry players don't all have comprehensive knowledge of the products (sensors) and technologies on the market or in development. On the other hand, the manufacturers of sensors are not necessarily aware of the most recent discussions regarding harmonisation of gas quality, injection of hydrogen etc.

The objectives of the workshop were therefore to:

- ◆ Inform stakeholders about expected future gas variations;
- ◆ Share knowledge about existing technologies and projects in development; and
- ◆ Indicate to sensor manufacturers where sensors are needed and what specifications are requested.

What do we mean by a sensor?

A gas sensor is a device that provides information about one or several characteristics of the gas it is measuring.

▼ The sensor workshop was held at the headquarters of GERG and Marcogaz in Brussels – the Hôtel van Eetvelde designed in 1895 by Victor Horta and now a UNESCO World Heritage site.



We are primarily looking at sensors that will help to solve the challenges of variations in gas quality and cover different applications. Today's technologies include correlative devices, gas leakage detectors, gas chromatograph detectors and spectroscopic devices/detectors.

Workshop programme and outcomes

The workshop programme included the following points:

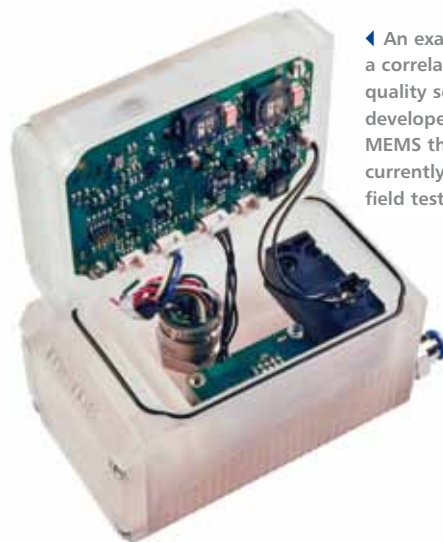
- ◆ Information about future gas quality;
- ◆ Information from manufacturers on existing technologies and developments;
- ◆ Existing reviews of technologies and comparisons; and
- ◆ On-going projects.

The context of the event was presented at the outset with presentations by Kristóf Kovács of the European Commission's Directorate General for Energy and European gas industry representatives¹.

Mr Kristóf emphasised the importance of gas quality for realising the Single European Energy Market. In the future, gas quality variations in Europe will be more frequent and of higher amplitude than today due to greater diversification of supply. It is vital to understand gas quality (and particularly the Wobbe Index which is an important measure of combustion characteristics) in order to ensure safe combustion of natural gas. In turn, cheap, fast and accurate sensors allied to effective measurement and control systems will be needed to ensure that safe combustion is taking place and can be appropriately managed.

Many options are already in operation and there will be more in the future. The relevant applications range from monitoring and control of distributed gas, through to control at the individual user level.

Transport is becoming a major application with the increasing success of natural gas (CNG



◀ An example of a correlative gas quality sensor developed by MEMS that is currently being field tested.

and LNG) fuelled vehicles and ships. Collaborative efforts from original equipment manufacturers (OEMs) and engine manufacturers to integrate sensors into a new fleet of heavy-duty vehicles were presented. This application may lead the way in creating a new market for mass production of small sensors, and new integrated chip-based devices such as micro-electrical mechanical systems (MEMS) are rising to the challenge.

For domestic users, integrating gas quality sensing and control into individual appliances, especially boilers and water heaters is an ambition that has so far only been realised in very small numbers. One early need is a cheap Wobbe meter which can be used by gas installers to check gas quality at point of use. Pipeline solutions may move away from the expensive total gas analysis chromatography based systems towards cheaper correlative type devices. These can be installed at the increasing number of entry points, and give sufficient confidence in the main quality parameters. Here regulatory rather than technical hurdles need to be overcome to ensure their widest use.

The diverse technical approaches to sensor development demonstrate that this is a field which is not short of possible technical solutions. The workshop showed that sensor manufacturers have an important need for infor-

¹ Presentations available at www.marcogaz.org/index.php/gas-sensors-workshop-2014.

mation from the gas industry on gas quality variations and application specifications for sensors in the industry. Therefore it is important for the gas industry to convey the correct messages to potential developers, manufacturers and integrators, so that the solutions will meet the needs. With this in mind, the workshop organisers will continue to work closely together to define the next steps and an action plan and roadmap that can be communicated back to the sensor community.

Sensors seem to offer solutions to a number of challenges that gas quality variation will bring. The workshop was a first step for a joint industrial effort toward solutions to manage these variations automatically and with increased confidence.

For more information please contact the authors or you may want to join the group "Gas sensors and gas quality" on LinkedIn.

Daniel Hec is the Secretary General of Marcogaz (www.marcogaz.org), Robert Judd is the Secretary General of GERG (www.gerg.eu.) and Jean Schweitzer is a Project Manager at the Danish Gas Technology Center (www.dgc.dk).

Energy Delta Institute Introduces Blended Learning

By Milan Vogelaar

Although the first correspondence degree was offered by the University of London in 1858, learning has traditionally been something that took place in a classroom and on the job. In recent decades developments in technology

and learning platforms have enabled learning to take place at any time and any location, and the American Society for Training & Development (ASTD) estimates that US organisations spent approximately \$156.2 billion on employee learning and development (L&D) in 2011.

Online learning or "E-learning" has evolved in the last decade and is becoming a large sector: Certifyme.net estimates that E-learning in the US is a \$56.2 billion business – roughly 30% of the total US L&D market. The Energy Delta Institute (EDI) as an international energy business school is actively involved with implementing these developments in our educational portfolio.

E-learning

The term E-learning was first used in 2004 and since its inception has undergone a rapid evolution. Businesses and institutions are transforming their classroom programmes to include online courses or are developing entirely new E-learning programmes. The reasons for this trend are the many advantages of E-learning, most obvious are the flexibility and the cost savings from not having to travel or spend time away from work. E-learning enables learning to take place without taking people away from the office for longer periods of time; this is beneficial for both the employer and the employee. For businesses with a remote workforce and telecommuting employees it is obvious that when training is provided, at least a part of it is provided via the internet.



ENERGY DELTA INSTITUTE | ENERGY BUSINESS SCHOOL

Energy Delta Institute (EDI) is an international energy business school. Through a variety of energy education programmes and networking activities we prepare energy professionals for challenges they face in their dynamic environment. The changing energy world is

forcing energy companies to innovate in order to stay competitive. In addition, the energy sector is confronting the possibility of a growing shortage of qualified personnel in the coming decades. The sector has only one choice: to invest in knowledge.

Continuous education for the gas industry

So how do these developments affect the gas industry? The industry has an expanding workforce which needs training, certification and education. However, these needs are often treated as one-off events, with little or no reinforcement after the fact. Education is a continuous process and the development of its employees is one of the key factors in a company's success. E-learning will play a large role in professional development and provides access to education for extended periods of time to deliver true capabilities and performance improvements to businesses. For that reason, EDI has been implementing E-learning throughout its programmes and is developing blended learning courses as well as developing stand-alone E-learning courses.

Online learning platform

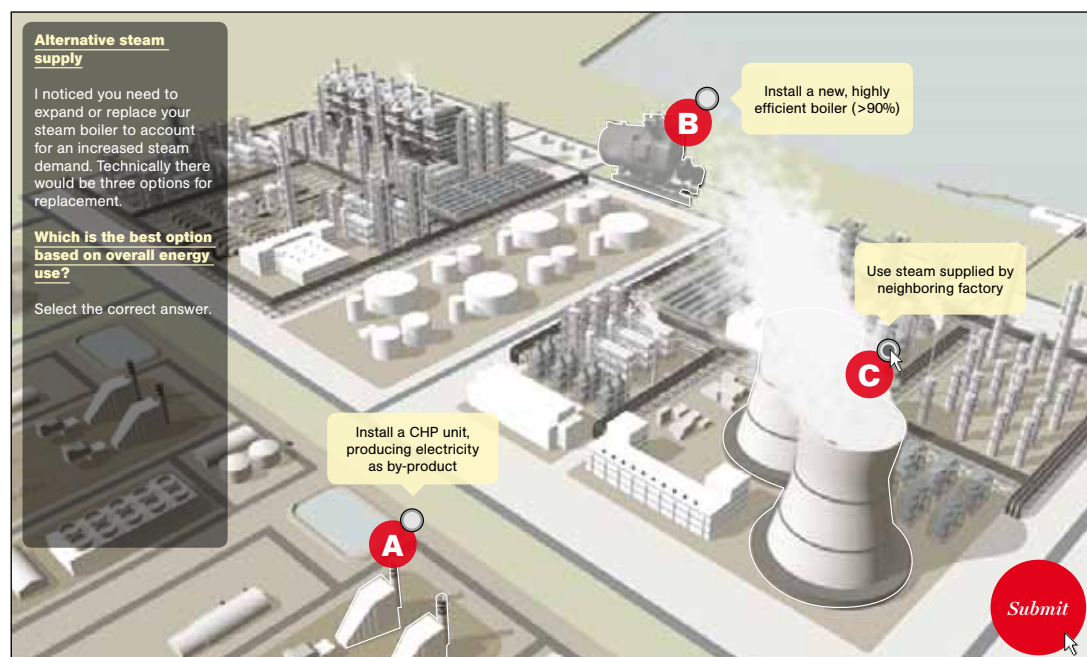
What is needed to provide E-learning to employees? As with regular training or education which takes place in a classroom, E-learning requires a learning environment. This environment is often called an online learning

platform and provides access to classes, educational materials, tests, assignments, grades, assessments and external resources. An online learning platform is also a social space where students and teachers can interact through discussions and (peer) assessments.

Online learning platforms are the basic component of E-learning and allow for:

- ◆ Content management – content creation, storage, access to and use of learning resources;
- ◆ Curriculum mapping and planning – lesson plans, assessment and personalisation of the learning experience;
- ◆ Learner engagement and administration – managed access to learner information, resources, tracking of progress and achievements;
- ◆ Communication and collaboration – messages, notices, discussions, video and blogs.

The online learning platform allows learner progress and results to be tracked through learner analytics. Learner analytics is the analysis of data of learners in order to improve education and performance.



◀ One of EDI's e-learning modules.

Blended learning

The combination of classroom learning and E-learning is called blended learning. It combines the benefits of student-teacher discussions in the physical classroom with additional E-learning resources. When blended learning is properly applied, the best of two worlds is combined resulting in better student performances. Because educators are becoming increasingly aware of the advantages and learners expect it, blended learning is expected to increase in popularity in the coming years.

E-learning at the Energy Delta Institute

As an international energy business school the Energy Delta Institute has been heavily involved with E-learning. We believe the trend of online education will continue to grow and our customers ask for blended learning programmes. Therefore we provide our learners with an intuitive online learning platform and interactive E-learning content. Participants in our courses can engage with our project managers, have access to learning materials and engage with other participants through discussions on the platform. EDI continuously improves its educational programmes and online learning platform to ensure satisfied customers.

The E-learning content developed by our in-house development team consists of interactive story-based modules with 3D animations. The learner has a role to fulfil in the module and is part of the story. The E-learning content thereby captures and maintains the attention of learners to achieve maximum effect. Because EDI has a dedicated E-learning team we can provide custom-built E-learning modules for the energy industry at request.

Milan Vogelaar is the manager of online education at EDI. To learn more about E-learning at the Energy Delta Institute visit: www.energydelta.org.

Expanding the Impact of Collaboration

By Paul Armstrong

As energy markets continue to evolve, there is a need for ongoing investment in advanced technology to address changes, along with new opportunities to lower energy intensity and consumption, provide significant economic and environmental benefits, reduce risk, enhance pipeline safety, increase operating efficiency, and help maintain system reliability and integrity.

Natural gas utilities recognise the value of supporting critical technology development as well as the importance of leveraging their investments with others who have similar interests to minimise the risks and improve the potential for success.

Gas Technology Institute (GTI) works in broad collaborative projects to reduce the time and investment of getting new technology to market. We offer a consortium approach, through which a group of interested companies fund and help steer the direction of a project, while GTI manages the programme and performs much of the research.

Members of the consortium pool their resources for financial leverage and to capitalise on supplemental programme funding from federal and state government sources and other industry stakeholders, benefitting utilities and their customers.

After a decade of programme successes in North America, we are now expanding the reach of collaborative projects to an international audience.

Technology supporting natural gas infrastructure

Operations Technology Development (OTD) is one such entity, which was established in 2003 as an independent not-for-profit corporation led by 22 members who serve over 28 million natural gas consumers in 27 US states and Canada. OTD develops, tests and deploys new technologies related to integrity, safety and reliability of gas infrastructure and operations.

Through a unique structure, focused planning, and built-in flexibility, the OTD programme addresses the industry's major needs and research challenges in distribution and transmission while providing companies with opportunities to support initiatives of specific interest.

OTD is well positioned to bring a wide array of benefits for both users and providers of natural gas. OTD supports research that results in useful information on various aspects of gas delivery and operations – such as pipe and leak location, pipe materials, repair and rehabilitation, excavation and site restoration, pipeline integrity management and automation, operations infrastructure, environmental, renewables and gas quality – delivered via technical reports, models and software tools.

Automating accurate, high-quality field data collection

GTI has developed mobile geospatial technology to automate the process of collecting data about underground assets for surveys, inspections, repairs and new installations. Satellite positioning, mobile GIS (geographic information systems), tablet computers and barcode scanning replace paper forms and records, optimising the entire data management process for utility operations.

GTI and OTD played a key role in the design and development of 3-GIS Mobile 2.1 – Android-compatible software with gas industry functionality.

The step-change technology collects data directly within a GIS environment, eliminating the need for back-office processing or data conversion. Real-time, sub-metre accurate GPS and an application to convert tracking and traceability barcodes into GIS features are integrated. The technology uses information in a barcode to automatically populate data fields, thus eliminating the need for manual data entry.

To further develop the mapping technology, GTI partnered with Nortec, a leading Israeli-based manufacturer and distributor of compre-



◀ GTI has developed mobile geospatial technology to automate the process of collecting data about underground assets.

hensive custom solutions for identification and traceability in harsh environments, to create a process to capture fusion tracking and traceability information. Under a grant funded by the Israel-US Binational Industrial R&D (BIRD) Foundation, GTI and Nortec have developed technology to capture fusion parameter data, convert it to a barcode, and create a label with a 50-year life. With the fusion feature, GTI's technology is now a comprehensive tracking and traceability solution for pipes, fittings and fusions.

GTI has now established LocusView Solutions, a subsidiary of GTI International, to provide comprehensive mobile mapping and field data collection services customised for the natural gas industry. Services include software licensing and configuration, hardware selection and set-up, cloud hosting, deployment and implementation, training and back-office integration. Visit www.locusview.com to learn more.

Shaping the energy future with new efficient end-use technologies

Utilization Technology Development (UTD) is at the forefront of cooperative research, development, and deployment for end-use equipment and appliances. As a not-for-profit corporation established in 2004 and led by 16 member

► GTI has designed and demonstrated an ultra-high efficiency gas-fired heat pump water heater (GHPWH) through laboratory proof-of-concept testing.



companies, over 22 million natural gas customers in 25 US states and Canada are represented. UTD directs and sponsors a wide-ranging programme to showcase the benefits of natural gas in residential, commercial, industrial, power generation and transportation markets.

UTD creates efficient and cost-effective new technologies, identifies emerging needs and solutions, and complements utility energy efficiency programmes. By taking R&D projects identified by members from the laboratory to the field, UTD enhances market success via field

► GTI worked with Cummins Westport to develop a new heavy-duty engine that operates exclusively on CNG or LNG.



testing and demonstrations. Working with commercial partners, UTD is performing technology and market assessments to enhance the competitiveness of gas-fuelled equipment and provide consumers with emission and energy-cost savings, benefitting both businesses and families.

High-efficiency heat pump space conditioning

GTI has specialised expertise in residential space conditioning, with a focus on traditional and next-generation heat pump solutions for HVAC systems. Researchers are also subject matter experts in advanced tank and tank-less water heaters, as well as heat pump and solar thermal systems.

For example, GTI conducted a series of tests of the NextAire 8-ton and 15-ton gas heat pumps (GHP) in commercial applications. This advanced unit uses variable refrigerant flow and multizone capabilities (up to 33 zones for the 15-ton unit) to efficiently heat and cool commercial building space with substantially less electricity requirements (up to 80% reduction). The NextAire GHP products are commercially available through IntelliChoice and its qualified dealers.

In another project funded by UTD, researchers are partnering with absorption technology



start-up Stone Mountain Technologies and water heater manufacturer A.O. Smith. GTI has designed and demonstrated an ultra-high-efficiency gas-fired heat pump water heater (GHPWH) through laboratory proof-of-concept testing. Field testing is now paving the way to a commercial launch anticipated in 2016.

GTI is also working with Stone Mountain Technologies on a \$1.5 million Department of Energy (DOE)-funded project to develop a low-cost, high-efficiency natural gas absorption heat pump for space heating that has promise to reduce heating costs by 30-45%.

Natural gas vehicle (NGV) engines

GTI worked with Cummins Westport Inc. (CWI), with support from UTD and the California Energy Commission, to develop and commercially launch a new heavy-duty engine that operates exclusively on CNG or LNG. A major new product introduced to the market in 2013, the CWI ISX 12G natural gas engine targets regional trucking, vocational and refuse markets. The engine promises to improve fuel economy up to 10% from current spark-ignited natural gas-powered engines used in Class 8 trucks and reduce GHG emissions by 20–25%.

GTI is also supporting CWI in the development of a 6.7-litre ultra-low emission medium-duty dedicated natural gas engine, ideal for school bus, package delivery and class 5-7 trucks.

Creating an impact in the market and value for customers

GTI worked with the North American natural gas industry to establish OTD and UTD to support cooperative energy research. Stakeholders in these collaborative efforts are benefitting from broad industry input, coordination and substantial funding leverage. Innovative tools, enhanced processes and advanced equipment are being delivered to the marketplace.

To build upon this successful history and accomplish things that couldn't be done on an individual basis, utilities worldwide now have a

similar opportunity to combine interests, expertise, and resources into focused R&D projects. Companies from diverse locations can come together to exchange information and ideas and tap into the experience of others, leading to more comprehensive outcomes and greater value.

Paul Armstrong is GTI Director of Business Development. For more information, contact him at paul.armstrong@gastechnology.org or +1 781 449 1141.

NGV Global 2014 – An Unqualified Success

By David Perry

At every level, NGV Global's 2014 conference and exhibition, co-located this year with Alternative Clean Transportation (ACT) Expo 2014, was a success. Anecdotes abound about it being the best that people have been to in a long time, perhaps ever. Many alternative fuel interests were represented but the "hero" of the event was undoubtedly natural gas – the fuel that is constantly breaking new ground reminiscent of the adoption of diesel in the last century.

After attending, an independent international certification company became convinced that NGV Global was delivering on its objective to be a global advocate for natural gas as a

▼ Dr Mike Gallagher, the newly appointed NGV Global Chairperson, addresses a large audience at NGV Global 2014.





▲ The NGV Global 2014 – ACT Expo 2014 exhibition attracted some 200 exhibitors.

transportation fuel, and was one of several companies that have inquired about joining and supporting the work of our Association.

Also, a global leader in measurement instrumentation informed NGV Global of more than €300,000 (\$405,000) sales from contacts made at NGV Global 2014; just one of many productive outcomes.

Altogether, more than 4,400 attendees engaged in four days of informed discussion and knowledge sharing, ride and drive action, high quality networking and technology debate.

North American exhibitors expressed repeatedly their excitement at being able to engage with the international NGV community, creating new networks and forging new pathways for technology and product sales. More than 200 American and international exhibitors filled the entire Long Beach Convention Center, many taking the opportunity to launch new products. Thirty natural gas vehicles were on display, with four more available for "ride & drive".

New officers for NGV Global

As a precursor to the conference and exhibition, NGV Global held its annual General Assembly, which included the election of new officers. Dr Michael Gallagher has been appointed the new Chairperson of NGV Global's Board of Directors. He currently serves as Chair of the

Board of Agility Fuel Systems, and is former President and Chief Operating Officer of Westport Innovations. Dr Gallagher was, until recently, Chairman of the 60-organisation Natural Gas Group of the two-year US national energy study, the DOE NPC Study of Future Transportation Fuels.

Dr Gallagher takes over the role from Alicia Milner, President of the Canadian Natural Gas Vehicle Alliance. Milner continues to serve NGV Global's Board as Immediate Past Chair.

Also amongst the newly appointed officers is Lennart Pilskog, Secretary General of NGVA Europe since the beginning of 2014, who was elected as Vice Chairperson of NGV Global. Pilskog is an industry veteran with almost 40 years of experience in virtually all vehicle segments of Volvo.

The General Assembly also appointed Andrew Dougherty, Swagelok Company, as the new treasurer. The treasurer and Board are supported by Executive Director, Diego Goldin and by me as Business Manager, with Dr Alex Lawson supporting the Association in technical activities.

The NGV Global 2014 Conference and Exhibition culminated in a Gala Dinner where NGV champions from around the world were recognised – people and organisations who by their actions and endeavours have promoted and inspired the development of a significant NGV programme or activity.

Transportation Village at WGC 2015

Next year NGV Global will co-host IGU's Natural Gas for Transportation Village as part of the 26th WGC in Paris, profiling the rapid growth of natural gas as a transportation fuel. It will include a seminar stage with a free-to-attend programme providing additional education opportunities specifically targeting on-road, off-road, marine and rail applications.

David Perry is the Business Manager of NGV Global (www.ngvglobal.com).

unlocking the global potential of natural gas



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NGV2014 Brussels: Gas to Drive European Transport into the Future

By Puya Sepahzad

NGVA Europe's fifth international show and workshops – NGV2014 Brussels – was held on July 8-10, three months after the EU's adoption of a Directive on the deployment of alternative fuels infrastructure. Themed "Drive the Change Bio CNG & LNG: The green, affordable and real alternative for all transport modes", Europe's NGV gathering of the year underlined the strong alliance between the natural gas vehicle industry and European policy makers.

Why Brussels?

On April 15, the European Parliament gave its final approval to new rules that ensure the build-up of infrastructure for alternative fuels across Europe (see box page 56). The Directive on the deployment of alternative fuels infrastructure for the first time requires Member States to set targets that make infrastructure available for the most common alternative fuels, including refuelling points for CNG and

LNG. The fact that national binding targets will only have to be developed for CNG, LNG and electricity shows gas-powered mobility will play a major role in Europe's fuel strategy and that the Directive can be regarded as a milestone for the development of the European NGV market.

In addition, NGV2014 Brussels tied in perfectly with the very encouraging development of the Belgian market for NGVs, which is currently experiencing a substantial uptake. Methane proved to be the star fuel at the Brussels Motor Show 2014, where OEMs sold as many NGVs in January 2014 as over the whole of 2013. The price reduction per car granted by the gas sector combined with manufacturers' promotional incentives were met by increasing customer demand, causing NGV sales to virtually skyrocket.

Hence, Brussels proved to be the perfect location to host NGVA Europe's event of 2014, which was hosted by l'Association Royale des Gaziers Belges (ARGB), the Belgian gas industry association and IGU Charter Member, and organised by NGV Communications Group.



► At the opening ceremony of NGV2014 from left to right are: Juan Vazquez, Lennart Pilskog, Siim Kallas, Philippe Van Deven, Willy Segers and Karel De Ridder.



◀ Lennart Pilskog addresses the NGVA-EU breakfast debate with the Director General of DG MOVE, Aguiar Machado (third from left), the Italian EU Presidency and country and industry representatives present.

Opening ceremony

The gathering officially kicked off in the early evening of July 8 with an opening ceremony in Hall 1 of the Brussels Kart Expo. Present were Juan Vazquez (Chairman of ARGB), Willy Segers (Mayor of the city of Dilbeek), Karel De Ridder (Alderman for the Environment of Dilbeek), Philippe Van Deven (NGVA Europe Vice Chairman) and Lennart Pilskog (NGVA Europe Secretary General). The ceremony's keynote speech was delivered by EC Vice President and Commissioner in charge of transport Siim Kallas.

In his speech the Commissioner stressed the importance of the alternative fuels Directive, a "milestone" on the way to developing a transport system fit for the 21st century. With gas being "a very important element in the whole initiative", Kallas moreover emphasised the relevance the Directive has for the growth of the European NGV market, to which he referred as "a market likely to develop into a customer base with great potential for European business and manufacturers".

Though the Commission and industry were hoping for even more ambitious targets, the approved Directive certainly provides a solid basis for natural gas to play a major role in reaching the EU climate goals whilst creating new jobs for Europe, Kallas pointed out. "This is where industry can, and should, play a vital role – both at home and on the world stage – with

investment so that Europe achieves its ambitious aims," he said, before cutting the ribbon and officially inaugurating NGV2014 Brussels.

NGVA – EU breakfast debate

Earlier that day, activities commenced with the EU breakfast debate themed "The methane for transport (r)evolution – where does Europe stand?". The exclusive meeting brought together high-ranking EU decision makers such as the Director General of the Directorate General for Mobility and Transport (DG MOVE), João Aguiar Machado, Member States and leading representatives of the NGV-related industry. Overall, participants agreed that natural gas will play a key role in a diversified energy mix fueling Europe's transport, and that an orchestrated effort involving politics and industry will be necessary in order to further push the development of Europe's market for NGVs.

Workshop sessions with prominent representation

NGV2014 Brussels' workshops featured a series of highly specialised sessions, in which experts from industry and the European Commission shared their knowledge with participants. Each module was facilitated by an expert in the field, with several members of the European Commission being present.

During the opening of the workshops, Lennart Pilskog and Didier Hendrickx of ARGB

addressed the main industry objectives whilst setting up the scenario for future development and growth for NGVs in Belgium and Europe. "This is the time when we have to act, the journey has just started," Pilskog emphasised, while Hendrickx shared with the audience success factors and obstacles experienced in the recent uptake of the Belgian NGV market.

Among the prominent speakers in the interactive workshops was Magdalena Kopczynska, Director for Innovative and Sustainable Mobility in DG MOVE. Kopczynska underlined that NGVs today are not "science fiction" but represent a proven and mature technology that shall be further applied in order to fulfil the EU targets in terms of reducing dependency on oil and diminishing greenhouse gas emissions.

The Commission was also present in the form of Liam Breslin, Head of Unit Surface

Transport (DG Research and Innovation) and Valeriu Dan Dionisie, Head of Unit DG SANCO (Health & Consumers), who presented the interesting findings of a study on "The Market for Vehicle Fuels as Experienced by Customers". In addition, leading companies such as Volvo, Daimler, Iveco and many others presented their latest innovative solutions whilst major European fleet operators delivered first-hand experiences from the successful operation of NGVs in company fleets.

Exhibition, study tour and more

The exhibition inside Brussels Kart Expo – Hall 1 included key vehicle manufacturers such as Fiat, Volvo, Iveco, Audi and Mercedes Benz, prominent component manufacturers as well as key NGV stakeholders and associations. Furthermore, delegates had the opportunity to test drive NGVs outside the exhibition hall. The European NGV industry seized the stage and showed that it manufactures high quality products utilising state-of-the-art technologies.

Delegates to NGV2014 Brussels were also offered a study tour to LNG sites located in the Port of Antwerp. They visited Belgium's first LNG & L-CNG station – recently opened as part of the EU's ongoing LNG Blue Corridors Project – and were able to inspect the port's LNG terminal operated by Fluxys LNG.

In addition, NGVA Europe held its General Meeting during NGV2014 Brussels.

NGVA Europe highly appreciates the support received during this year's event. Special gratitude goes to the NGV Communications Group, the organiser of NGV2014 Brussels, ARGB for hosting it and the sponsors Volvo, CNH, Fiat, Fluxys, GNVERT and GRT Gaz. NGVA Europe already looks forward to meeting you in 2015 from June 1-5 in Paris at the Natural Gas for Transport Village within the 26th World Gas Conference's exhibition.

Puya Sepahzad is the Press Officer of NGVA Europe (www.ngvaeurope.eu).

▼ A wide range of vehicle and component manufacturers exhibited at NGV2014.



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- Gas infrastructure is a highly versatile asset for transmission and storage of huge amounts of energy at low cost. New technologies such as power-to-gas will make the gas system even more flexible in the future energy landscape.

European Parliament Supports Roll-out of NGV Infrastructure

The European Parliament has given its final approval to new rules to ensure the build-up of infrastructure for alternative fuels across Europe and the development of common technological specifications, including CNG and LNG refuelling points. Welcoming the Parliament's decision, Lennart Pilskog, Secretary General of NGVA Europe, said "this is big positive forward for methane as a vehicle fuel".

The Directive was approved in April and establishes a common framework of measures for the deployment of alternative fuels infrastructure in the EU. More specifically, the Directive sets out minimum requirements on alternative fuels infrastructure build up, to be implemented through Member States' national policy frameworks, including common technical specifications for refuelling points for natural gas (LNG and CNG).

Vice-President and Commissioner for Transport, Siim Kallas, noted that the transport sector needs certainty that enough refuelling and recharge points are available, but regretted that they could not convince the Council to accept a more ambitious text especially on infrastructure objectives.

Overall, it is still a good outcome as the text requires Member States to set targets to make infrastructure available for the most common alternative fuels. For CNG infrastructure and electric charging, the agreement foresees adequate refuelling for cities and densely populated areas and the deadline of 2020 was preserved; for CNG and LNG refuelling points along the TEN-T core network, the deadline has been moved to 2025 (five years

later than the Commission preferred).

National binding targets will only have to be developed for CNG, LNG and electricity, while the deal offers more flexibility to Member States for developing hydrogen refuelling points. CNG and LNG will play a major role in Europe's fuel strategy and the NGV related industry will work closely together with national governments during the 24 months to come when developing national policy frameworks.

NGVA Europe furthermore welcomes a specific amendment on user information and request for better fuel price transparency:

"Simple and easy to compare information on prices of different fuels could be important for vehicle users to better evaluate the relative cost of individual fuels available on the market. Therefore, when displaying fuel prices on a fuel station, in particular for natural gas and hydrogen, unit price comparison to conventional fuels, such as "1 petrol litre equivalent", may be displayed for information purposes."

CNG is sold in kilograms, hence the customer is simply not aware of the fact that CNG is the cheapest fuel (1 kg CNG = 1.5 litres of petrol).

The main measures agreed are:

- ◆ Minimum levels of infrastructure across the EU that require Member States to submit to the Commission national plans for minimum levels of infrastructure – refuelling and recharging stations – for alternative fuels;
- ◆ EU wide standards for the infrastructure, including standardised refuelling equipment for natural gas;

- ◆ Clear consumer information to facilitate use including on the recharging and refuelling stations themselves, as well as comparison of prices for the different clean and conventional fuels.

With regard to natural gas and biomethane, Member States will now have to develop national action plans to provide the appropriate infrastructure for CNG and LNG refuelling (road and maritime) according to the following provisions:

- ◆ 2020 target CNG: adequate refuelling in urban agglomerations and densely populated areas;
- ◆ 2025 target CNG/LNG (road): minimum number of filling stations along the TEN-T core network (150km for CNG and 400km for LNG mentioned as indicative maximum distances);
- ◆ 2025 target LNG (shipping): refuelling in a sufficient number of TEN-T seaports;
- ◆ 2030 target LNG (shipping): refuelling in a sufficient number of TEN-T inland ports;
- ◆ Common technical standards for CNG and LNG refuelling points by 2015;
- ◆ Consumer information: the unit price per "1 petrol litre equivalent" may be used (dealt with in a separate document)

The Directive foresees a market assessment and possible revision of the initiative by 2027. Publication of the Directive after legal-linguistic screening will supposedly take place in the second half of 2014. Following the vote of the European Parliament, the new rules should be formally adopted by Council later this year.



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PRCI Breaks Ground on Technology Development Centre

By Cliff Johnson

On July 7, Pipeline Research Council International (PRCI) broke ground on a new Technology Development Centre (TDC) in Houston, Texas. The TDC is a major commitment by the energy pipeline industry to address the key issues that it is facing to ensure the safety of the national and international pipeline system.

Since the creation of the PRCI pipeline repository in 2012, PRCI has been progressively building a unique, world class inventory of pipeline samples to support technology development. The benefits of having such an establishment available to the industry have already been realised, as the current site has been utilised for evaluation and development of new technologies, providing a location for accumulation of former in-service pipe materials with real-world pipeline features/flaws that are invaluable to PRCI's R&D programme and the industry, and supporting industry-sponsored workshops. The TDC will open with over 600 test specimens available for advancing pipeline research. It will be a key enabler to understanding and improving current inspection and integrity assessment technologies, and promoting the development of new technologies for pipeline integrity management.

"The TDC is a critical tool for the energy pipeline industry as we continue to strive for

zero failures. The TDC will provide the industry with an independent third-party site to fully understand the capabilities of current tools and to guide the development of the new technologies needed to push towards our goal. This new site will further enhance PRCI as a focal point for the R&D efforts of the energy pipeline industry," said John O'Brien, Chevron ETC.

The new TDC will be located on over eight acres (3.2ha) and will include a five-acre (2ha) state-of-the-art pull test facility, and an over 20,000ft² (1,850m²) workshop and test facility with an additional 9,000ft² (850m²) of office and meeting space. "This new site will allow us to continue to grow our pipeline sample inventory and to perform the research needed to ensure the safety and integrity of our vital pipeline infrastructure globally," said Eric Amundsen (Energy Transfer), Chair of the TDC Steering Committee.

The effort to locate the new site has been spearheaded by the PRCI TDC Steering Committee made up of PRCI members and staff who have been heavily involved in TDC operations since its inception and understand the incredible opportunities and benefits the pipeline industry can reap from its utilisation. PRCI would like to acknowledge the members of the Steering Committee for their dedication and support, as well as the PRCI member companies that have and continue to contribute samples and sponsor the TDC's operations.

▼ An artist's impression of how the new TDC will look when completed in 2015.



The members of the Steering Committee are: John O'Brien, Chevron ETC; Eric Amundsen, Energy Transfer; Mark Piazza, Colonial Pipeline Company; Scott Collier, Buckeye Partners, Cliff Johnson, PRCI; Mike Whelan, PRCI; and Steven Trevino, PRCI.

We recognise all PRCI contributing companies for their support in this initiative with specific mention of additional support from GDF Suez, Marathon Pipe Line LLC, Petrobras, Colonial Pipeline Company, Southern California Gas Company, Chevron and Energy Transfer.

Cliff Johnson is the President of Pipeline Research Council International (www.prci.org). For more information regarding the TDC or to show your support and get involved, please contact him at cjohnson@prci.org or +1 703 205 1600 ext. 114.



◀ The PRCI pipeline repository is a valuable resource.



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The future of the gas industry: new opportunities driven by cooperative competition

By Alexander Medvedev

My fellow gas industry colleagues!

I am sure you will all share my joy that, contrary to decades of prejudice in the international energy industry, now is a wonderful time to work in the gas industry. As an industry, we have a wonderful opportunity to work together, in cooperative competition, to continue this successful dynamic. I believe that our continuing success should be built around a number of key themes that dominate our industry:

- Being flexible and understanding the needs of our clients
- Gas as the only viable green option
- Gas as a transportation fuel
- Gas prejudice: subsidies for nuclear and green
- Commitment to partnerships, which will drive growth

I hope this year will be successful to all players in our market and I look forward to continued cooperative competition from you all.

Flexibility: committed to meeting the needs of the client

Whilst we are of course constantly looking to the horizon, running R&D projects into the future applications of natural gas, we should never forget the symbiotic relationship between producer and client, near unique in the modern industrial world. We must understand our clients' needs, and the fluctuating nature of demand. Industrial capacity and weather conditions mean that a client might need more or less gas at the same time each year. We all have to be flexible.

During the last two winters there have been cold snaps that were unforeseen in Europe. With other producers either at capacity, shutting down fields for maintenance, or unable to meet deliveries due to political disturbances, we were able to meet our clients' significantly enhanced demands.



Alexander Medvedev

Our finance department would have been delighted for us to sell at the higher prices prevalent in a spot market situation. This, however, would have been a betrayal of the bond of trust that must be at the heart of the gas industry, where often there is a physical linkage between up- and downstream as well as financial. The pipeline as an umbilical cord, if you will. Alternative scenarios are too fixed to the benefit of one side or another, whether financial or operational; we need to maintain a balance between up- and downstream needs.

It is the commitment to our clients that has led the industry to invest billions of dollars in upstream exploration and development activities. Gazprom and our partners have successfully run ultra high tech operations to develop Russia's natural wealth in complex physical, geological and environmental situations – operations mirrored the world over throughout the industry. The investment does not stop here. We are all also investing in the mid- to downstream sector. New and planned export pipelines are specifically designed to ensure that demand will be met, no matter what the

circumstances. The same can be said of the growth of LNG. Gas is gas no matter how it is produced or transported. Conventional, tight, CBM or shale. Pipeline or LNG – it is all the same.

While demand is projected to grow during the next few decades – we are delighted to agree with Exxon's view on the gas market – we are also aware that we must invest to ensure security of supply, no matter what. It is this demand that is driving multi-billion dollar investment in some of the world's most ambitious engineering projects, be they located in Russia, Europe, North America or the Pacific.

Gas – the only currently viable green option?

Perhaps we should rebrand gas? At Gazprom we often refer to it as the “blue fuel”, but it strikes me that “green fuel” should be used. Of course there is a certain amount of pollution derived from the production and combustion of natural gas; however, the reality is that it is by far the cleanest hydrocarbon: 30% cleaner than oil and a massive 45% cleaner than coal. I believe that there is a grand alliance



to be created: the integrated energy industry; governments and regulators around the world; public health organisations and finally environmental campaigners. We are not always the most comfortable of bedfellows, but I believe we have a common enemy and that is coal.

Whilst long-term carbon pollution is doing serious damage, the short-term danger is just as bad. The pollutants present in coal smog are deadly to urban populations. Charles Dickens, famous for his descriptions of “London fog” was actually writing about coal-based smog. Since the removal of coal-fired power stations and the introduction of natural gas, Londoners are living longer lives, with respiratory diseases down significantly. China is following the same path, investing in both local and imported gas solutions for power generation that will lessen their reliance on coal, thereby improving public health, and maintaining industrial output.

Gas is a medium-term force for better public health and a long-term bridge to a non-carbon future, once the technologies are both operational and financially viable. In the long term the world is realising that burning coal is frankly unsustainable for our planet.

Our friends in environmental NGOs should be promoting the use of natural gas. In the current global economic environment, and remembering it's not sunny all the time and the wind doesn't always blow; natural gas is the only green alternative to burning coal and oil; whether for power generation, heating, or as fuel for transportation.

Gas as a transportation fuel

We believe that gas will become a viable transportation fuel. From long-distance commuters to municipal transportation, continental HGVs and finally as a marine bunkering fuel, we are successfully investi-

gating the future of gas as a transportation fuel and have created a small scale, but successful and entirely scaleable retail business in Germany.

Such a new part of the energy industry demands that we work in partnership, and we have both enjoyed and profited from working with major international companies such as Volkswagen and E.ON, sharing our technology and experience. We have also been a driving force, in cooperation with the IGU on two versions of the “Blue Corridor Rally”. These events, utilising gas-powered vehicles are designed to raise the profile and prove the concept of gas as a transportation fuel to a much wider audience.

As an industry, we need to work together to convince regulators, politicians, motor manufacturers and finally consumers that gas really is an attractive alternative to more mainstream fuels.

Environmental persecution?

The simple truth is that gas is persecuted because it is a hydrocarbon. We must work together to demonstrate gas's clean credentials and fight to rebalance the global system of environmental policy/subsidy dynamic. Nuclear enjoys numerous state-backed subsidies around the world because it is “low carbon”; however, we are all aware of the risks of a catastrophic incident. Perhaps more damaging are the environmental and fiscal costs associated with decommissioning and clean up.

In the gas industry, we are of course all aware of our advantages over nuclear. One of the most important is speed. A CCGT system takes a fraction of the cost and time associated with the commissioning, regulatory and operational processes of its nuclear equivalent. There are a number of markets considering what should be done with ageing nuclear infrastructure. They cannot put these decisions off forever. I believe the entire gas industry should put

the case for gas as a partial replacement for nuclear. We are clean, we are efficient, we are environmentally friendly, and over the lifetime of the project, we are cost effective.

On the other side of the low carbon equation are the truly green alternatives. Of course we understand that genuinely green technologies need to be encouraged. However, we would suggest that if regulators and governments around the world genuinely want to have a positive effect on the environment, the subsidies given to green power need to be reconsidered into R&D, not power generation. Of course there are perfect places to harvest the power of the wind or sun; however, it is equally true that the currently available technology does not work as efficiently as gas solutions in much of the world. Let gas be the bridge to a greener future, and stop persecuting us because of our dirtier cousins, oil and coal.

Partnership at the heart of our industry

Gas has a near unique status in the global industrial economy. Due to the inherent nature of the industry, market and the commodity itself, it demands total commitment to two intertwined concepts: partnership and flexibility.

We have to work together. Success is therefore driven by long term partnership. Of course there will always be tensions between parties, but our positive experience is that we are successful when our partners are successful. It is through this spirit of competitive partnership that I hope the international gas industry will continue to go from strength to strength.

Alexander Medvedev is the Deputy Chairman of the Management Committee of OAO Gazprom and Executive Chairman of Gazprom Export.

Perth to Host LNG 18

By Mark Blacklock

The world's leading liquefied natural gas forum is the LNG X series of conferences owned by IGU, the Gas Technology Institute (GTI) and the International Institute of Refrigeration (IIR). For the 18th International Conference and Exhibition on LNG in 2016, the baton has been passed to Australia and IGU Charter Member, the Australian Gas Industry Trust, supported by Associate Member, the Australian Petroleum Production & Exploration Association (APPEA).

"LNG 18 will be held in Perth, April 11-15 and will be indisputably the most important global gas event in 2016," says Barbara Jinks, Executive Director of the National Organising Committee (NOC). "Being owned by IGU, GTI and IIR, three of the most influential LNG organisations, LNG 18 is guaranteed to attract the highest level speakers and share world-first insights with participants."

"With two thirds of our reserves located in three basins off the Western Australian coast, Perth, Western Australia's capital city is the ideal location for LNG 18," declares Grant King, Chairman of the NOC.

Currently the world's number three LNG exporter with 22 million tonnes in 2013, Australia is set to surpass Qatar to become the top LNG exporter by the end of the decade. Innovative developments include the first LNG plants to use unconventional gas as a feedstock and the largest floating liquefaction project.

The venue for LNG 18 will be the Perth Convention and Exhibition Centre in the heart of the city. Some 5,000 participants from 60 countries are expected to attend to discuss the latest developments in the LNG business. There will also be technical tours and a full range of social and networking activities.

▼ The Perth Convention and Exhibition Centre (foreground) will be the venue for LNG 18.





◀ LNG 18 is being promoted at major energy events. Seen at Gastech 2014 are (from left to right): Brigitte Petrie, Gemma Collocott, Didier Coulomb of IIR, Barbara Jinks, Robby Clark and Rodney Cox.

The call for papers is now open and the deadline for submission of abstracts via www.lng18.org is April 2015 (see *Key Dates box*). They will be evaluated by the LNG 18 Programme Committee, a 45-member team of LNG experts chaired by Dr Nirmal Chatterjee.

On the back of the outstanding success of the LNG 17 exhibition in Houston and having successfully run each LNG-X exhibition since LNG 12 in 1998, Exhibitions and Trade Fairs (ETF) is managing LNG 18's exhibition. It is anticipated that there will be 19,000m² of exhibition space with more than 200 exhibitors showcasing their products and services.

Companies interested in exhibiting at LNG 18 or in sponsorship opportunities can contact Robby Clark at ETF on rclark@etf.com.au.

The LNG X conferences started in 1968 and they have settled into a three-yearly cycle. Australia has hosted the event once before in Perth in 1998.

The LNG 18 website www.lng18.org is the first stop for more information and you can also keep up to date with the latest news via Facebook (LNG 18 Conference & Exhibition) and LinkedIn (LNG 18 – Perth).

Mark Blacklock is the Editor-in-Chief of International Systems and Communications.

▼ Grant King, NOC Chairman for LNG 18 (second right) is congratulated by IGU President, Jérôme Ferrier (right) at the end of LNG 17 as IGU Vice President, David Carroll (centre) looks on.



Key Dates



April 20, 2015	Deadline for submission of abstracts
June 1, 2015	Registration opens
June 16, 2015	Notification to authors
January 18, 2016	Deadline for submission of final papers
April 11, 2016	LNG 18 opens

Build-up to the 26th World Gas Conference

By Daniel Paccoud

With less than a year to go, excitement for the world's largest and most prestigious gas event, the 26th World Gas Conference (WGCPARIS2015), is building. This is the fourth of a series of updates on preparations for the event, which will take place in Paris, June 1-5, 2015.

► Daniel Paccoud, NOC Chair.

► Annie Louys, NOC Secretary.

Under the theme "Growing together towards a friendly planet", WGCPARIS2015 will welcome high-level delegates, speakers, visitors and media to discuss the present and future roles for natural gas as an integral part of a sustainable global energy system.

IGU's flagship, five-day triennial event attracts thousands of participants from around the world, making this a platform through which to gather critical inputs and to chart new strategies for the industry. The World Gas Conference has often been termed "the Olympics of the gas industry" due to its important contribution to the development



of natural gas and mapping the road to a low-carbon society.

The credentials of natural gas are indisputable; however, natural gas faces challenges and obstacles in positioning itself as a key energy source, particularly in the policy arena. As the spokesperson for the gas industry, IGU advocates for natural gas to ensure it has an appropriate policy voice, consistent with its merits and potential.

▼ The venue for WGCPARIS2015 will be the Porte de Versailles Convention Centre.



WGCPARIS2015 will showcase major industry achievements since the 25th World Gas Conference in 2012, and participants will have an opportunity to meet and network with colleagues from 100 countries. World-renowned speakers will discuss current and future industry developments, and 350+ exhibitors will showcase the latest the industry has to offer. Numerous social and technical networking events have been organised for participants to grow their global network, showcase their findings and build strong partnerships. The high quality of speakers, topical and comprehensive conference content, and the opportunity to network with industry leaders and experts in their fields, have consistently drawn the most influential delegations to the World Gas Conferences.

Conference programme and exhibition

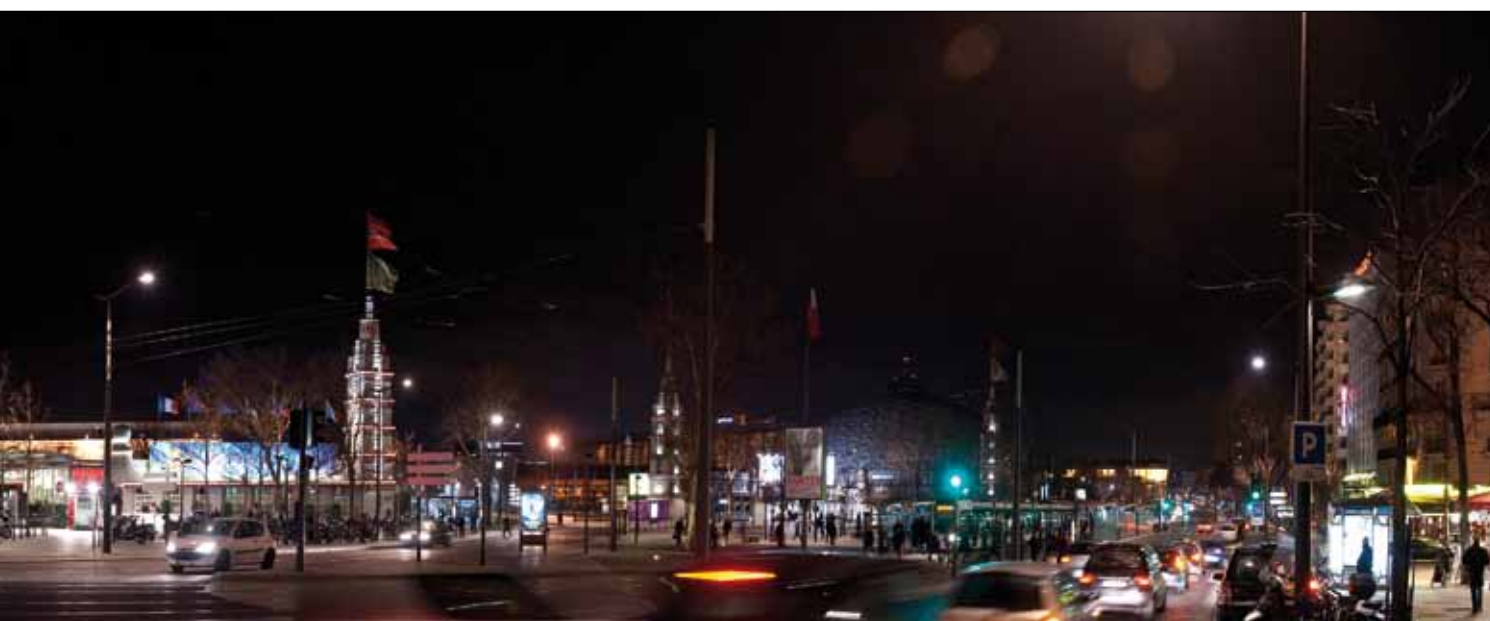
The WGCPARIS2015 conference programme is rich with a variety of speakers combining years of industry experience who will present high-quality discussions that aim to address critical issues from the past, present and most importantly, the future.

It will feature more than 500 expert speakers presenting their findings and knowledge on the latest developments and challenges facing the gas industry, as well as offering ideas on how to combine renewables and electricity to meet the ever changing and growing demands of the world's energy requirements.

The programme will be the culmination of three years of studies and research conducted by over 1,000 industry professionals who make up the 14 IGU Working Committees, Programme Committees and Task Forces.

The French Presidency has worked hard to ensure the conference will be interesting and innovative. My colleagues Georges Liens and Yves Tournié, respectively Chair and Secretary of IGU's Coordination Committee, give you more information about the programme in the following article.

Designed to be fully integrated into the conference facility and programme, the 45,000m² exhibition space will showcase more than 350 exhibitors. There will be country-specific pavilions and – for the first time – a Natural Gas for Transportation Village. Co-hosted by NGV Global and NGVA Europe, the village will profile the rapid growth of natural gas as a transportation fuel.





▲ Daniel Paccoud with IGU Secretary General, Torstein Indrebø at the 21st WPC in Moscow.

Networking

WGCPARIS2015 will be an exceptional opportunity to meet with industry peers and build business partnerships. A series of networking events will be organised for delegates and one of the highlights will be a gala evening at the Grand Palais, located in the heart of Paris near the famous Avenue des Champs Élysées. Other networking events to look forward to include:

- ◆ The opening ceremony in the Palais des Sports with welcome addresses from the IGU President, Jérôme Ferrier and the French President, François Hollande;
- ◆ Five technical tours to the Céré-la-Ronde UGS facility, Fos Cavaou and Dunkerque LNG receiving terminals, Montereau power plant and Alfortville interconnection grid;
- ◆ The WGC golf tournament on May 31, 2015, which will take place at Le Golf National, one of the top 100 courses in the world and the venue for the Ryder Cup in 2018;
- ◆ A range of social and post-conference tours which have been carefully designed to offer you opportunities to explore the beautiful country of France;

- ◆ The closing ceremony during which the incoming US Presidency will be introduced after looking back on the success of the French Presidency and outcomes of WGCPARIS2015;
- ◆ The farewell party will mark the end of the event as delegates gather together under the theme "Franco-America".

Global marketing reach

The WGCPARIS2015 team has been attending key industry events to engage with colleagues and clients and answer your questions. We had a stand at the 21st World Petroleum Congress (WPC) in Moscow in June and at press time were getting ready for IGRC2014 in Copenhagen. For details of our participation in future events and any other information please visit the website www.wgc2015.org.

The whole team looks forward to welcoming you to Paris.

Daniel Paccoud is the Chair of the National Organising Committee for WGCPARIS2015.

Contacts and Key Dates

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dpaccoud@wgc2015.org

NOC Secretary
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Exhibition sales
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rclark@etf.com.au

Registration now open, deadline to register with the Early Bird rate – January 16, 2015

WGCPARIS2015 website –
<http://www.wgc2015.org>

WGCPARIS2015 LinkedIn group –
<http://bit.ly/igu-mag>



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Introduction and Key Developments

By Georges Liens
and Yves Tournié



▲ Georges Liens.



▲ Yves Tournié.

We are now in the final year of the French Presidency culminating in the 26th World Gas Conference in Paris, where the work of the technical committees and task forces will be presented. WGC 2015 will take place June 1-5 under the theme for the French Triennium 2012-2015: "Growing together towards a friendly planet".

Part of IGU's role is to advocate for the development of natural gas, not only as a transition fuel, but also as a long-term solution for sustainable economic growth and a more secure energy future for populations in every region, managed by competent and motivated people. WGC 2015 will provide us with a golden opportunity to further these aims.

Thousands of international delegates, policy-makers and top executives of major gas companies will attend the conference, and tens of thousands of industry professionals will visit the wide-ranging exhibition.

Conference programme organised around four pillars

We have chosen to dedicate each day of the conference to the four transversal themes or "pillars" of the French Presidency, which have guided the works of the technical committees and task forces during the triennium:

- ◆ Natural gas, a core pillar for a sustainable future of the planet (Tuesday, June 2, green pillar);
- ◆ Gas with renewables and electricity: together a perfect combination (Wednesday, June 3, yellow pillar);
- ◆ Natural gas, a growth factor for new economies (Thursday, June 4, red pillar);
- ◆ Human capital for the future of the gas industry (Friday, June 5, blue pillar).

Each luncheon session from 12:15 to 13:45 will address the daily theme and the following organisations will be fielding speakers: UNFCCC (Tuesday, green pillar), IEA (Wednesday, yellow pillar), World Bank Group (Thursday, red pillar) and UNESCO (Friday, blue pillar).

There will be 20 plenary sessions with key-note speakers, which will take place in the 4,000-seat Palais des Sports arena from 10:30 to 12:00 in the mornings and 14:00 to 15:00 in the afternoons.

The WGC 2015 technical programme will take place mainly in Pavilion 2. There will be 14 strategic panels addressing some of the main issues and challenges facing the gas industry, with experts and industry leaders invited to provide their views and to ensure lively debates. The panels will have a chair and up to six panellists who will each have five minutes for an initial presentation, while the debate and Q&A with the audience will be scheduled for 45 minutes. The panels will be held each afternoon from 15:15 to 16:45 and on Friday morning.

The topics studied by the 14 technical committees and task forces will be presented in 42 thematic sessions which will be held each morning from 08:30 to 10:00 and each afternoon from 17:00 to 18:30. These presentations are being selected following the call for abstracts which closed on September 1, and will be the culmination of three years of studies and research conducted by more than 1,000 industry professionals.

Interactive sessions

New for the 26th WGC is the use of the Wisemply system to enhance interaction between the speakers and the audience. As well



as the traditional roving microphone, participants can ask questions via SMS, Twitter and the web. Questions are displayed on the main screen in the meeting room. Wisembly also allows live voting sessions with the question appearing on participants' devices for them to vote on and the result appearing on the main screen.

WGC 2015 Youth Programme

The Youth Programme of the World Gas Conference aims at attracting a new generation of professionals to the gas industry. Following the successful initial event during WGC 2012 in Kuala Lumpur, the programme for WGC 2015 has been expanded. It will cover three full days, with an opening welcome on Tuesday evening (June 2) and a closing ceremony on Friday afternoon (June 5).

Around 200 talented students and young professionals from all over the world will have the opportunity to participate in the programme that will revolve around two themes: attracting young people, especially women, to the industry; and securing energy for all.

We encourage you to visit www.wgc2015.org regularly for updates on the programme and look forward to welcoming you to Paris.

Georges Liens is the Chair and Yves Tournié is the Secretary of the Coordination Committee.

▲ The plenary sessions will take place in the Palais des Sports.

Members of the IGU Committees and Task Forces, Top 10 Countries of Origin (as of August 2014)

WOC 1 Exploration and Production	73	Russia	118
WOC 2 Storage	84	France	116
WOC 3 Transmission	103	Iran	48
WOC 4 Distribution	90	The Netherlands	42
WOC 5 Utilisation	76	Korea	39
PGC A Sustainability	69	Algeria	39
PGC B Strategy	98	Spain	36
PGC C Gas Markets	58	Brazil	34
PGC D LNG	122	Poland	32
PGC E Marketing and Communication	56	Japan	30
PGC F R&D and Innovation	46		
TF 1 Human Capital	49		
TF 2 Gas Advocacy	41		
TF 3 Geopolitics	36		
Others	29		
Total	1030		



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Since 1975, the National Oil Company of Côte d'Ivoire, Petroci, ensures oil and gas exploration and production in Côte d'Ivoire and abroad.

To this end, it has improved its organization by acquiring logistics and strategic infrastructures, mainly for the logistics base of Vridi, the Abidjan- Bouaké pipeline, the expansion capacity of Gestoci in Yamoussoukro and the new filling station with a capacity of 300 tons / day and a new storage tank of 400 tons / day.

To date, 218 wells were drilled and 29 blocks over 50 were allocated (thus 30% of our sedimentary basin being explored).

The Government, by intensifying exploration activities, aims to rapidly reach a production of 200,000 barrels of oil per day and 300 million cubic feet of natural gas per day.

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Progress Reports from the Committees

This chapter contains news and information from IGU's five Working Committees and six Programme Committees.

Working Committee 1 – Exploration and Production

For the fourth meeting of the 2012-2015 Triennium WOC 1 and PGC A continued their tradition of working together and this time they also joined forces with PGC C. The event was hosted by the Korea Gas Union (KGU) in the Renaissance Seoul Hotel, March 10-13.

A total of 77 IGU authorities, delegates, guests and accompanying persons from 20 countries attended the meeting, including Georges Liens, CC Chair; Seok-Hyo Jang, CEO of KOGAS and candidate to the Presidency of IGU for the 2018-2021 Triennium; Jae-Seob Kim, Secretary General of the KGU; Bong-Suh Lee, former Minister of Trade and Industry; Yoon-Hoo Lee, former Minister of Knowledge Economy; and Kang-Soo Choo, IGU Regional Coordinator for Asia and Asia-Pacific. WOC 1's Chair, Denis Krambeck Dinelli (Petrobras, Brazil)

➤ Delegates to the joint meeting of WOC1, PGC A and PGC C in Seoul pose for a group photo (BELOW) and in the opening plenary session (OPPOSITE).





was unable to attend and WOC 1's Secretary, Marcos de Freitas Sugaya (Petrobras, Brazil) acted in his place. In total, there were 19 delegates from WOC 1.

Joint plenary session

After a brief welcome from the chairs of PGC C, Gi-Chul Jung, PGC A, Satoshi Yoshida, and the acting chair of WOC 1, Marcos de Freitas Sugaya, the meeting started with a speech from Seok-Hyo Jang.

Kun-Ho Lee (KOGAS, Korea) then gave a presentation on the current status of the Korean gas industry.

Karen Sund (Sund Energy, Norway) was unable to attend the meeting but kindly forwarded her presentation on the positioning of gas in the energy market.

Sanjeev Gupta (Ernst & Young, Singapore office) reviewed the major oil and gas transactions registered in 2013.

Ross McVey (Gazprom Marketing & Trading, UK office) examined European gas-to-power demand which has been declining over the last four years mainly due to competition from lower-priced coal.

Jaishankar Krishnamurthy (Ernst & Young, Singapore office) looked at the pricing implications of the new supply and demand scenario for global LNG operations.

Leslie Palti-Guzman (Eurasia Group, USA) listed some key future challenges that gas buyers will face in Asia particularly in terms of supply risk and pricing.

Georges Liens reviewed work on the preliminary programme for WGC 2015 (which was subsequently published in April). As the sessions will only be 90 minutes long, the number of speakers will be limited to about five, which will be enough for presentations of 15 minutes followed by three minutes of Q&A. WOC 1 also asked the CC to include the strategic panels in the call for papers to increase author competition and the overall quality of the conference.

▼ WOC 1's Secretary Marcos de Freitas Sugaya (left) with Kang-Soo Choo, IGU Regional Coordinator for Asia and Asia-Pacific (right). Behind them is Jae-Seob Kim, KGU Secretary General.



WOC 1 sessions

Marcos de Freitas Sugaya reminded delegates of the most important results of the previous meeting in Kota Kinabalu, and said that the main task in Seoul was to produce a first draft of WOC 1's triennial report. Ideally, he continued, it would contain the most important actions and best practices to be adopted by the upstream segment of the gas industry. The introduction should be captivating enough to encourage the reader to proceed, but reasoning must be properly developed to support the conclusions. Figures, texts and tables taken from other sources should not be reproduced without written consent, and their authors must be properly quoted.

SG 1.1 Technical advances in gas exploration and production

Leader (and WOC 1 Vice Chair): Adif Zulkifli (Petronas, Malaysia)

SG 1.1 is focusing on the technologies that are most relevant for the production of unconventional gas, such as horizontal drilling, multi-stage stimulation and microseismic monitoring. The study group is further expected to establish best practices aiming at the exploration and production of hydrocarbons in a safe, efficient and environmentally sound manner. This work could be integrated with the new edition of the shale gas publication that is being prepared by IGU under the leadership of the CC Vice Chair, Mel Ydreos.

SG 1.1 is also looking at technologies that are relevant to the reduction of gas flaring and venting, including FLNG and FGTL. During WGC 2015 a strategic panel on the issue will be chaired by the new manager of the World Bank-led Global Gas Flaring Reduction partnership (GGFR), Bjørn Håmsø, who has asked the committee to emphasise the role of technology in reducing flaring and venting.

Marcos de Freitas Sugaya reprocessed some flaring data published by the GGFR, suggesting that technology should be particularly impor-

tant for developing countries where significant amounts of gas are still being flared. New upstream facilities in these countries should be designed to minimise flaring and venting, and the study group could identify some best practices for that.

The draft report produced by the study group contains an introductory section and a good review of some important reservoir and drilling technologies. Although well structured, a section on the most important production systems is still under development. The gas monetisation section and the case study presented will also require some work, with more focus on technological innovation. The current content of the gas-to-power subsection seems to be more related to the scope of activities of WOC 5; a different approach will be required there as well.

SG 1.2 Assessment of global gas reserves and resources

Leader: Mohammed Kaced (Sonatrach, Algeria)

Marcos de Freitas Sugaya tried to negotiate the use of figures and data on drilling for conventional gas with IHS CERA, but permission was granted for only one figure, in which gas discoveries are shown to have recently fallen to their lowest level in many decades, in spite of a considerable increase in exploration activity. As the success ratio decreases and a severe inflation is observed in upstream activity, it is hard to believe that prices could be reduced, as the unconventional gas revolution remains confined to North America.

SG 1.2's draft report contains a section on unconventional gas whose definitions will be consolidated by the next meeting. This is a theme of relevance, as the English word "shale" is often confused with "schist" in Spanish, French, Portuguese and other languages, while the differentiation between shale and tight gas in the literature is often grey.

The other sections of the report deliver on how hub pricing is affecting upstream invest-

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Natural gas is expected to be the world's fastest growing major energy source through 2040. Utilities, industries and other consumers are choosing this fuel because it is versatile, abundant and produces relatively low emissions. In fact, natural gas emits up to 60 percent less carbon dioxide than coal when used for power generation. As one of the world's largest producers of natural gas, ExxonMobil is committed to developing this important resource. Because it's more than just a business opportunity ... it's an investment in the future.

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ment, and on the growing role of the independent producers of oil and gas. The study group is expected to complete its report by the next meeting.

SG 1.3 Gas rent and mineral property rights

Leader: Marcos de Freitas Sugaya

Marcos de Freitas Sugaya presented the most important results obtained by the study group, whose best practices recommend government authorities to focus on progressive instruments based on profits in lieu of signature bonuses, flat royalty rates and other regressive instruments based on production. Of the case studies investigated by SG 1.3, the USA was one of the most interesting, as government take there is the lowest, and additional efforts have been recently undertaken to further reduce the upstream taxation. However, a growing discussion is taking place there in the opposite direction, and this could severely hit the independent producers, which were ultimately responsible for the revolution of unconventional. According to a recent report by Wood Mackenzie, a reduction of 3.8 million bpd could be observed in 10 years if the current tax treatment of intangible drilling and development costs were ended in the USA.

Pawel Jagosiak (PGNiG, Poland) analysed the tax regime covering the Norwegian Continental Shelf. Activities are relatively expensive there, and the tax system is also complex, but at the same time there are many built-in incentives and many upstream companies have been attracted to this region as a consequence. In the vast majority of cases a minimal working commitment is required, the most common one being a drill or drop obligation. As shown during the meeting in Sapporo in September 2012, the marginal tax rate is 78% but the allowance for capital expenditure is also large (93%), with a 30% uplift, and the authorities refund 78% of the exploratory cost, minimising the impact of dry holes and cost overruns.

Pawel Jagosiak also described some of the upstream activity in Poland, where significant resources of unconventional gas have been announced in the press. Only 12 wells have been drilled so far by PGNiG, but nine more are planned for 2014 in the Baltic, Central Poland and Lublin Basins.

Zainal Abidin Zainudin (Petronas, Malaysia) presented some of the experience gathered in Canada by Progress Canada Energy Ltd., which is drilling in North Montney (British Columbia) and Deep Basin (Alberta). Typical drilling costs for shale gas have been around \$5 million per well there, and some logistical challenges still exist, but these have been confronted by means of a modular design of facilities and the use of a progress pod concept. In British Columbia a deep drilling credit is available for up to three years (3% royalty).

Taeh-Yeong Lee (KOGAS, Korea) wrote up the Mozambique and Tanzania case studies developed in the previous meetings.

The study group's draft report analyses the most important fiscal instruments usually applied to the upstream industry. It follows with a description of some case studies, including the USA, where a number of fiscal benefits have been applied to incentivise the production of oil and gas by independent companies. It then explains why gas should not be treated as oil, and finishes with some best practices aimed at government authorities.

Technical visit and next meeting

After a final joint plenary session, in which the study group leaders presented the progress of their work, delegates reconvened the next morning for a visit to the Incheon LNG terminal.

At press time, Repsol was due to host WOC 1's fifth meeting in Madrid, Spain, September 23-26. This will not be a joint meeting with PGC A but the two committees will get back together for their sixth meeting in February 2015.

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Working Committee 2 – Storage

WOC 2 is chaired by Ladislav Goryl (NAFTA, Slovakia) and has 75 members organised in three study groups. The committee's fourth meeting of the 2012-2015 Triennium took place at the Beaumont Palace in Pau, France, March 19-21. The event was co-hosted by five French companies: Transport et Infrastructures Gaz France (TIGF), Total, Storengy, EDF and Geostock, and attended by 39 delegates from 12 countries.

In the opening plenary session, Ladislav Goryl welcomed delegates and thanked the hosts for organising the meeting. Then there were presentations by representatives of the French gas industry. TIGF's Operations Director, Jean-Louis Olivet highlighted the company's strategic position at the crossroads of gas flows between northern Europe and North Africa. Total's CO₂ geological storage expert, Sylvain Thibau presented the results of the Lacq

pilot project for CO₂ storage in underground porous structures.

A workshop was organised looking at how the energy-efficient operation of gas storage can reduce its environmental footprint. Over two days, WOC 2 members and invited experts gave 10 presentations. All the presentations are available on the WOC 2 section of the Growing Together collaborative platform.

Andreas Böhmer considered one of E.ON Gas Storage's main slogans "Cleaner and better", and gave examples of projects the company has implemented to optimise operating costs and reduce environmental impact.

Lubomir Greif presented the results of NAFTA's work on optimising gas flows in the complex Lab UGS facility, which has a large infrastructure of reservoirs, entry-exit points and gathering stations. An important focus was on compressor optimisation to reduce fuel consumption.

▼ WOC 2 delegates pose for their group photo outside the Beaumont Palace conference centre in Pau.



PHOTO BY PAUL SUTHERLAND

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We transport natural gas from Italy to Europe and from Europe to Italy, crossing countries and borders. We guarantee the country's energy security through a gas transmission network of more than 32,000 km, 8 storage sites, 1 regasification plant and a domestic distribution network of more than 52,000 km. Employing 6,000 men and women across our territories, we manage a gas network which is highly integrated with our natural surroundings. Because only by creating a network of values can we plan for a bright future.



The network that respects the future.

► WOC 2's technical tour was of the Lussagnet UGS facility.



Dimitar Shterev from Bulgartransgaz reviewed the development of an empirical formula to estimate the maximum permissible depression of operational wells, which has enabled a significant increase in withdrawal rates of gas.

Jacques Grappe (Geostock) and Christophe Maisons (Magnitude) looked at "induced seismicity". Their presentation pointed out how seismic and micro-seismic monitoring can assist in identifying and assessing the effects of natural and induced seismicity from a risk mitigation perspective, thereby contributing to operational safety and optimisation of natural gas UGS in salt caverns, aquifers or reservoirs.

Jacques Grappe gave a second presentation in which he described a methodology to manage the integrity of UGS salt caverns and optimise their performance throughout their lifecycle. This methodology is based on the assessment and interpretation of monitoring data and the implementation of specific geo-thermo-mechanical modelling studies.

There were also presentations by Fabien Favret (EDF) on new technologies to increase the efficiency and reduce the environmental footprint of UGS, Professor Ermolaev (Gubkin State University of Oil and Gas) on the optimisation of UGS operational processes, Gaetano Annunziata (Edison Stoccaggio) on micro-

seismic monitoring, Nikita Barsuk (on behalf of I. Bebesko, Gazprom) on ejection technologies and Tang Ligen (RIPED-Langfang) on research into an analytical tool to estimate injection performance.

Additionally, Yves Tournié, CC Secretary, and Emmanuelle Wicquart from the NOC for WGC 2015 gave updates on preparations for the event.

Delegates divided into the study groups for their separate meetings, and the event was rounded off with a technical visit to the Lussagnet UGS facility. This is one of two storage reservoirs in the south-west of France which also supplies part of Spain.

SG 2.1 UGS database

Leader: Vladimír Lorenc (NAFTA, Slovakia)

Progress on the final concept of the new web application for updating the UGS database was discussed by SG 2.1's members. The application is still under development (export and dynamic charts will be added later). At press time, the aim was to have it fully functional for viewing and updating data from previous triennia. The most important task in the coming period is to finalise the data collection during 2014.

Analysis and visualisation of the database will be completed in spring 2015.

S.G 2.2 Techniques and new opportunities

Leader: Fabien Favret (EDF, France)

Members discussed the approach towards further work and completion of the final report which will describe the status of the technology applied today. The core topics of the final report will be the technology detailed in the articles published in the April-September 2014 issue of the IGU magazine and in this issue (see pages 166-174):

- Subsurface integrity management (well integrity management, reservoirs and caverns integrity management);
- Reducing the environmental footprint of UGS operations (reducing natural gas emissions, reducing methanol/glycol con-

sumption, compressor technology, ejectors, optimisation of operations and reduction of energy consumption);

- Storage of renewable energy – how UGS techniques might contribute to storing excess electricity generated from intermittent renewable energy sources and thus respond to some of the new challenges posed by the changes currently experienced in the energy sector.

SG 2.3 Human resources: Attracting students to storage activities

Leader: Nikita Barsuk (Gazprom, Russia)

SG 2.3's objective is to provide a status report on human resources and deliver some solutions for increasing the attractiveness of careers in the gas industry – especially in the storage sector. Ideas are being sought through a competition to mark the 100th anniversary of UGS for students and young (under 30) professionals working in storage companies. The winners will present their ideas during WGC 2015.

Nikita Barsuk assessed the current feedback on potential participants from universities and companies, which was provided by Gubkin State University of Oil and Gas. Members then discussed how to attract more competitors from their countries by sending personal invitations to selected people at universities.

SG 2.3 is also analysing the gender, demographic and skill characteristics of people working in the UGS sector by means of a survey to obtain more information for attracting people to the UGS sector.

Next meeting

At press time, WOC 2's next meeting was due to be hosted by Dong Energy and Energinet.dk in Copenhagen, Denmark to coincide with IGRC2014. WOC 2 meetings were set to be held September 15-17, allowing delegates to attend IGRC2014 afterwards.

Working Committee 3 – Transmission

WOC 3 is chaired by Benjamín Guzmán (Transportadora de Gas del Sur, Argentina) and has 110 members from 35 countries.

The fourth meeting of the 2012-2015 Triennium was hosted by Snam Rete Gas and took place at the Mercure Torino Royal Hotel in Turin, Italy, March 10-13. It was attended by 49 members from 25 countries, Yves Tournié, CC Secretary, and Emmanuelle Wicquart from the NOC for WGC 2015.

Benjamín Guzmán began business on the first day by welcoming delegates and introducing new committee members. He then set out the main objective of the meeting: to improve WOC 3's final report for WGC 2015 by review-

▼ Delegates to WOC 3's fourth meeting in Milan pose for their group photo.



► WOC 3's Chair, Benjamín Guzmán (*right*) with Nicola Battilana (*left*) during dinner at La Barrique in Turin.



ing the contribution of the three study groups with a focus on the introduction, conclusions and recommendations. After that, delegates divided into their study groups for discussions.

The plenary session was held on the second day. After a welcome from Benjamín Guzmán, Michele Ronchi of Comitato Italiano Gas (CIG), the Charter Member for Italy, gave an interesting presentation on the country's gas industry. The role of CIG is to conduct studies on technical and scientific problems, produce technical standards and support authorities, institutions, gas sector operators and other stakeholders.

Next up were the study group leaders who presented their activity reports (*see below*).

Then there were short reports on gas industry news from all the countries whose members attended the meeting, and five interesting technical presentations.

Simone Nobili (Snam Rete Gas) briefed delegates on the construction of a 172km pipeline between Zimella and Cervignano d'Adda, which involved more than 350 river, road and railway crossings.

Ian Fordyce (DNV GL – UK Oil & Gas) looked at pipeline safety in the UK with a focus on the measures taken by National Grid to reduce the risk of external interference.

Sung Baek (KOGAS, Korea) looked at the challenges of constructing pipelines in areas of dense population.

Andrzej Osiadacz (Warsaw University of Technology, Poland) presented his work on computer simulation of the CO₂ flow in pipelines used in carbon capture and storage projects.

Olga Cherkashina (SNG, Russia) gave an update on the use of electromagnetic acoustic transducer (EMAT) technology to detect pipeline cracks.

On the third day there was a technical visit to the Snam Rete Gas dispatching centre in San Donato Milanese and a presentation on real-time simulation by Michele Paganoni. Real-time simulation provides a current state reconstruction of the network, in transient conditions, according to telemetered flows, telemetered pressures and valve signals. Real-time functionalities allow look-ahead and what-if calculations to be made, starting from the reconstructed initial state.

At the end of each day's business sessions, delegates enjoyed a social programme prepared by Snam Rete Gas.

SG 3.1 New transmission projects, SG 3.3 Public acceptance and new technologies

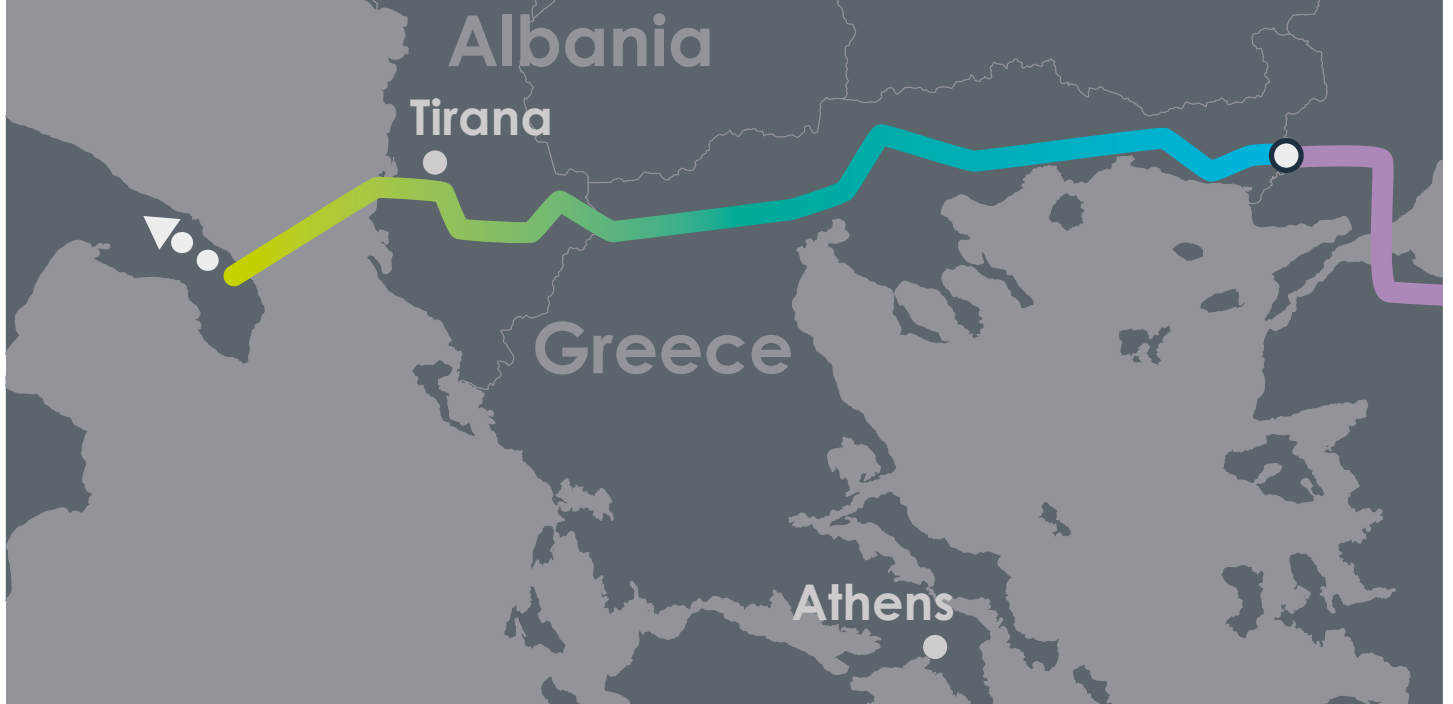
Leader: Peter Tóth (Eustream, Slovakia)

Deputy: Alessandro Moretti (Snam Rete Gas, Italy)

As mentioned in the previous progress report, the activities of these study groups fall into five subject areas: transmission projects, the compression process, the impact of new sources, public acceptance and new technologies, and research has been carried out via questionnaires and a survey of new gas transmission projects.

The Milan meeting was attended by 27 members of SGs 3.1 and 3.3, who reviewed the 10 chapters of the final report and worked on the abstract, conclusion and recommendation for each subject. The report will include appendices with details of 13 transmission projects.

Opening the Southern Gas Corridor



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SG 3.2 Pipeline integrity management systems (PIMS)

Leader: Abderrahmane Taberkokt (GRTG, Algeria)

Deputy: Mohd Nazmi (Petronas, Malaysia)

As mentioned in the previous progress report, SG 3.2's activities fall into four subject areas: ageing pipelines, third-party damage, threats analysis and PIMS, and research has been carried out via questionnaires and a survey. The study group is looking at the need to enhance integrity plans in order to reduce the risk of failure and accidents based on the PIMS approach. It is also responsible for building and maintaining a database of transmission systems in IGU member countries.

The Milan meeting was attended by 22 members of SG 3.2, who reviewed the structure of their final report and worked on proposed best practices, new technologies and lessons learnt from operating ageing pipelines, PIMS, threats and third-party damage.

Next meeting

WOC 3's fifth meeting will take place in Prague, Czech Republic, October 7-9. For further information about the committee's activities, please contact the Chair at Benjamin_Guzman@tgs.com.ar.

WOC 4 – Distribution

The spring meeting of WOC 4 was hosted by Sedigas and GasNatural Fenosa at the Hotel Wellington in Madrid, Spain, March 4-7. It was attended by 33 experts from the gas industry, representing 21 IGU member countries.

WOC 4 and its three study groups were able to make significant progress in their preparation of the committee's report for the 26th WGC next year in Paris.

The study groups took the opportunity to work on the content of their reports, and to define the key subjects for their sessions during the WGC.

SG 4.1 Regulation of third-party access (TPA) to gas distribution networks – A standard approach

Leader: José Carlos Broisler Oliver (Comgás, Brazil)

In addition to work on the TPA project, SG 4.1 is preparing an article for the next issue of the IGU magazine.

SG 4.2 Diversification of gas quality and non-conventional sources in a carbon-free future

Leader: Peter Flosbach (Westnetz, Germany)

SG 4.2 is taking biogas, SNG, hydrogen and

▼ Delegates to WOC 4's fourth meeting pose for their group photo at the Wellington Hotel in Madrid.



Natural Gas driving growth and environmental protection forward



DEPA leads the way in Greece

DEPA is the company that introduced natural gas to Greece's energy market by developing the necessary infrastructure and networks. It's a group of companies, consisting of the transmission system operator and three distribution companies. DEPA has a 50% stake in the company responsible for the construction and operation of the offshore gas pipeline connecting Greece with Italy and participates also in the company that will undertake the development and operation of the pipeline connecting Greece with Bulgaria. DEPA works for the further expansion of the natural gas grid in Greece, so that more consumers can benefit from the environmental-friendly energy solution.



▲ WOC 4 delegates visited EMT's CNG filling station where buses are refuelled and cleaned on the ground level and private vehicles are handled on the upper level.

shale gases into account for injection into existing natural gas distribution grids, monitoring the development of the regulatory framework for these "new" gases. This diversification is a great challenge – in particular for gas distribution grid operators. In many cases it is their grid in which such gases are injected, causing severe fluctuation of gas quality, with little possibilities to avoid such local fluctuation or even to pinpoint it. High-quality tracking systems catering for a range of grids (e.g. those with lower gas volumes and/or complicated structures) are under development and may help address the issue.

SG 4.3 Smart grids in gas distribution: Scope and purpose

Leader: Pascal Vercamer (GDF Suez, France)
Smart grids have multiple functionalities covering network safety, reliability, surveillance/maintenance, the ability to integrate new gases into the natural gas system and the possibilities of positive interaction with electricity networks. SG 4.3 will also join forces with PGC F to prepare a WGC strategic panel on smart grids in a sustainable future. Meanwhile, the study

group has contributed an article on smart gas grids to this issue (see pages 130-133).

Technical visit

After the business sessions delegates took part in a technical visit to the main bus depot operated by EMT, the local transport company of Madrid. Half of EMT's bus fleet runs on CNG and the depot at Sanchinarro on the outskirts of the city has a large refuelling station for the buses. Additionally, on the rooftop of the bus facility, GasNatural Fenosa operates a CNG filling station open to the general public.

Next meeting

WOC 4's next meeting will be organised by the Austrian Association for Gas and Water (ÖVGW) and hosted by OÖ. Ferngas Netz GmbH and Energie Steiermark in Vienna, Austria, September 30-October 3.

Working Committee 5 – Utilisation

By Said Akretche (Naftal, Algeria)

A record 150 people attended WOC 5's fourth meeting of the 2012-2015 Triennium, which was held at the El Aurassi Hotel in Algiers, April 28-30. The meeting was hosted by Naftal (a subsidiary of Sonatrach responsible for the marketing and distribution of petroleum products) under the aegis of IGU Charter Member, the Algerian Gas Association (AIG).

WOC 5's Chair, Eugene Pronin (Gazprom Export, Russia) was keen to take advantage of the African venue to organise a special session on gas utilisation in the continent. Held on April 28, this was attended by more than 100 delegates from 12 countries: Cameroon, Equatorial Guinea, Egypt, Gabon, Ivory Coast, Kenya, Mozambique, Nigeria, Republic of Congo, South Africa, Tanzania and Tunisia. The presentations looked at current gas utilisation in 16 countries and how it is likely to develop.

Committee sessions commenced after the African Gas Day. As well as the 29 WOC 5 members and 29 African delegates on the spot,

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İSTANBUL METROPOLITAN MUNICIPALITY



▲ WOC 5 delegates pose for a group photo at the El Aurassi Hotel in Algiers with their Chair, Eugene Pronin at centre.

a video link allowed three people who could not travel to Algiers to take part in SG 5.3's discussions.

An exhibition was organised in parallel with the work sessions. Exhibitors included Sonatrach, Naftal, Sonelgaz (the state-owned utility in charge of electricity and gas distribution in Algeria) ALNAFT (Agency for the Development of Hydrocarbon Resources), ARH (Hydrocarbons Regulatory Authority), AIG and IAP (Algerian Petroleum Institute). The foreign guests appreciated this initiative and were able to find out more about Algeria's natural gas industry.

Two technical visits were offered to guests: one to Naftal's LPG bottling plant in Sidi Arcine (Algeria is a major user of LPG) and the other to the gas-fired Hamma power station and Gué de Constantine CNG filling station, both operated by Sonelgaz.

The CNG filling station was opened in 2000, testifying to Algeria's interest in the development of NGV use. Indeed, hosting the WOC 5 meeting was an opportunity to showcase the country's initiatives in the sector. These include a campaign to raise awareness of the benefits of NGVs, the gradual conversion of refuse

▼ Visiting the Gué de Constantine CNG filling station.



vehicles to run on CNG, the purchase of new-build CNG buses and building a network of filling stations in the main cities. LNG is also being evaluated as a transport fuel, particularly in the marine sector.

During the event, numerous bilateral meetings were organised between representatives of Naftal and representatives of the foreign delegations to discuss opportunities for cooperation. The African countries in particular were interested in developing partnerships with Algeria in the field of gas utilisation. This event constituted a real opportunity for the company Sonatrach and her Naftal subsidiary to present their industrial capacities and their know-how in the field of the use of the natural gas.

A full programme was arranged for accompanying persons who visited the Roman ruins and Royal Mauritanian Mausoleum at Tipasa, which is a UNESCO World Heritage Site, Bardo Museum, the Palace of Dey and the Basilica Notre-Dame of Africa. There was even a class on how to make couscous.

Social events included a gala dinner at the El Aurassi Hotel which was attended by Ahmed Messili, Secretary General in the Ministry of Energy and Mining, and Abdelhamid Zerguine, CEO of Sonatrach. The event was rounded off with a farewell dinner on the beautiful terrace of El Boustane, a restaurant overlooking the Bay of Algiers.

Committee report

By Eugene Pronin

WOC 5's meeting held in Algiers was a great success. We would like to thank Naftal and all our hosts for the excellent organisation as well as the kindness and hospitality shown to all delegates. Please find below a short update on the work of the study groups and topic teams.

On transversal issues WOC 5 is liaising with PGC F (renewables and electricity), TFs 1 and 2 (human resources), PGCs A, D, E, F and GERG (sustainable development) and PGCs C and E (natural gas available everywhere).

SG 5.1 Industrial utilisation

Leader: Egidio Adamo, (Eni, Italy)

SG 5.1 is preparing a report on trends in industrial gas usage and 10 members attended the Algiers meeting. They discussed each member's contribution to the final report and preparations for the WGC 2015 sessions the study group is responsible for. SG 5.1's work focuses on fuel switching and energy services, energy efficiency, the combination of natural gas with renewables, gas-to-power and LNG use in industry.

▼ Visiting the Basilica Notre-Dame of Africa.



SG 5.2 Domestic and commercial utilisation

Leader: Martin Seifert (SVGW, Switzerland)

SG 5.2 is looking at the promotion and use of gas heat pumps and micro-CHP units with case studies of four national markets: France, Japan, Spain and Switzerland. The Algiers meeting was attended by 22 members who discussed the motivations of customers, boilers (high modulation and hybrid) and gas heat pumps. They also defined the structure of the study group's final report.

SG 5.3 Natural gas vehicles (NGVs)

Leader: Miriam Eklo (GDF Suez, France)

SG 5.3 has a new leader with Miriam Eklo taking over from Olivier Bordelanne. The study group is preparing a report on NGV markets around the world and information for each country has been collected through a survey. During the Algiers meeting, which was attended by 24 members, it was agreed that a revised and simplified version of the survey questionnaire would be re-circulated and also sent to African countries. The structure of the final report was discussed and responsibilities confirmed, and the sessions at WGC 2015 were planned. SG 5.3 is also working on a brochure which IGU and NGV Global can use to advocate for the use of natural gas as a transportation fuel but the change of leader has delayed work on this.

TT 5.1 Renewable energy, CO₂ emissions, hydrogen

Special Adviser: Aksel Pedersen (Dong Energy, Denmark)

Five members of the two topic teams attended the meeting in Algiers. TT 5.1 is looking at production and use of "green gases" in association with natural gas, investigating how renewables can be incorporated into the natural gas grid, and looking at hydrogen production from renewable power as well as at technologies to convert CO₂ + water to methane.

TT 5.2 Gas quality

Special Adviser: Maryuli Rodríguez Malaver (PDVSA, Venezuela)

TT 5.2 is looking at variations in gas quality around the world and is now headed by Maryuli Rodríguez Malaver, who has taken over from François Cagnon. The diversification of supplies, including the injection of renewable gases, is leading to an increase in gas quality variations while at the same time more stringent requirements are coming from end-users.

Next meeting

At press time, WOC 5's next meeting was due to be hosted by HMN Naturgas in Copenhagen, Denmark to coincide with IGRC2014. WOC 5 meetings were set to be held September 14-15 allowing delegates to attend IGRC2014 afterwards.

Programme Committee A – Sustainability

Chaired by Satoshi Yoshida (Tokyo Gas, Japan), PGC A works closely with WOC 1. The two committees were joined by PGC C for their fourth meeting which was hosted by the Korea Gas Union in Seoul, March 10-13 and attended by 21 PGC A members. The joint events have been covered in WOC 1's progress report so this report will focus on the sessions of PGC A's four study groups.

SG A.1 Carbon capture and storage

Leader: Susumu Nishio (Tokyo Gas, Japan)

SG A.1's report will explore the recent development of CCS technologies and their challenges with regard to economic feasibility, legal framework and social acceptance, and also consider the perspectives for CO₂ utilisation. Members from NIGC, PDVSA, Petronas, Sonatrach, Tokyo Gas and Total are working on the chapters.

During the WGC 2015 committee session, recent experiences from CCS implementation in the gas industry will be shared, and the latest R&D projects on capture, transport, storage and utilisation will be highlighted. Topics of interest

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▲ PGC A's Chair, Satoshi Yoshida (left) with WOC 1's Secretary, Marcos de Freitas Sugaya (centre) and PGC C's Chair, Gi Chul Yung (right) in Seoul.

▼ During their joint meeting delegates of PGC A, WOC1 and PGC C made a technical visit to the Incheon LNG receiving terminal.

include: the practical implementation of CCS in the gas industry; technology; economic feasibility; legal framework; social acceptance; best practices and experience in technology; perspectives and challenges of CO₂ management in the gas industry; potential business opportunities in the future; collaboration with other sectors (CO₂ compression, piping, storage, utilisation); and R&D for CO₂ utilisation.

SG A.2 Natural gas and renewable gas

Leader: Elbert Huijzer (Liander, The Netherlands)
SG A.2's report and committee session will look

at the economic, environmental and social aspects of renewable gases like biogas, bio-methane and biosyngas. The focus will be on actual cases, projects or strategies to fully exploit the environmental and social benefits and to improve the economic possibilities for renewable gases. The topics of interest include: certification and trading issues; the economics of renewable gas projects and the need for financial incentives; international standardisation of sustainability criteria for renewable gases; LCA of a specific renewable gas chain; showcasing the social advantages of a successful project; and marketing, both in terms of the image of renewable gases and removing market barriers.

SG A.3 Life cycle assessment of the natural gas chain

Leader: Anne Prieur-Vernat (GDF Suez, France)
As part of its work programme SG A.3 has launched a survey on the level of knowledge about LCA in the gas industry via the Growing Together collaboration platform.

In its committee session speakers will demonstrate how LCA may be applied to the natural gas industry and share some practical applications. The scope of the session includes, but is not limited to, greenhouse gas emissions and climate change. Other environmental impacts may include water footprint (linked both to scarcity and to water pollution), local impacts linked to atmospheric emissions and resources depletion. All end uses of natural gas may be included, e.g. power generation, cogeneration, heating and transport. The production of conventional natural gas as well as unconventional gas and biogas/biomethane are part of the scope of this session. Topics of interest include: technological improvement; monitoring environmental performance; communication; and definition and ranking of actions towards lower impacts.

As well as its committee session SG A.3 is organising a special panel to demonstrate how





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SG A.4 Environmental aspects of unconventional gas

Leader: María Gabriela Roselló (Total, Argentina)
SG A.4 has a new leader with María Gabriela Roselló taking over from Mauro G. Soares (Tecpetrol, Argentina). The study group aims to improve public acceptance of unconventional gas (UCG) production by providing a balanced approach to the discussion about its environmental impacts based on science, fact, technological innovation and management best practices. Its report will build on IGU's publication *Shale Gas – The Facts about the Environmental Concerns* which was released at WGC 2012.

During SG A.4's committee session, speakers will examine the best practices and technologies that could be implemented to satisfy the most stringent standards, setting the scenario for a debate on the future of UCG. Topics of interest include: improvements in the efficiency of hydraulic fracturing techniques and in well productivity; clean hydraulic fracturing; water management and fracture flow-back management and reuse; social communication case studies and/or innovations; and logistics and surface issues management and innovations.

The joint special panel with WOC 1 will analyse the main barriers that must be overcome if the UCG revolution in North America is to be replicated in other countries. These include: infrastructure requirements; fiscal incentives; regulations; business models; and best practices to improve performance and reduce the environmental footprint.

Next meeting

At press time, PGC A was due to hold its fifth meeting in Helsinki, Finland, September 10-12. The committee is also working with the CC to organise a workshop on sustainable development during the Council meeting in October.

PGC B – Strategy

Under the chairmanship of Fethi Arabi (Sonatrach, Algeria) PGC B's principal objectives are to analyse the forecasts, policies and economics affecting regional and global gas supplies, demand and trade; to examine wholesale gas price formation and gas pricing trends for both indigenous production and international trade; to share information on company strategies in relation to commercial and regulatory change; and to coordinate work on a project identifying scenarios for the gas market by 2050. There are three study groups.

PGC B's fourth meeting was hosted by Gasunie in Amsterdam, The Netherlands,

► PGC B delegates pose for their group photo in Amsterdam.





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Pavel Zavalnyy
President
of the Russian Gas Society

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▲ Delegates to PGC B's fourth meeting included Torstein Indrebø and Yves Tournié.

April 23-25, and attended by 58 delegates. During the meeting, the steering committee (Sonatrach and Gasunie) examined the status of the 2050 natural gas prospective study which is being carried out by PGC B with the participation of other IGU members.

PGC B is also leading a survey on access to energy for developing countries. Energy poverty is a hot topic nowadays and the United Nations is addressing the issue. Potentially synergies could be developed between the UN's and PGC B's work. The main preliminary findings from the answers received to the survey are:

- ◆ There is no common definition of energy poverty;
- ◆ All consumers are concerned about sustainable energy;
- ◆ Some countries have energy poverty measures for all types of energy, whereas others do not have any measures at all;
- ◆ Some countries have measures that state that customers cannot be cut off.

SG B.1 World gas supplies, demand and trade

Leader: Thomas Dirksmeyer (E.ON, Germany)

SG B.'s working sessions in Amsterdam brought the group several steps further on the way to completing the final report for WGC 2015 in Paris. There were presentations giving an overview of EU gas demand and Eurogas policies, and on the Asia-Pacific region.

On the quantitative side, SG B 1 now has preliminary supply and demand figures per

region – mainly based on IEA figures, but also on studies by organisations such as the US Energy Information Administration (EIA), Energy Research Institute of the Russian Academy of Sciences (ERI RAS) and Japan's Institute of Energy Economics (IEEJ).

It has been decided to organise the final report in two main parts, the first one covering and briefly describing the world gas supply and demand balance by region and on a global scale, whereas the second part will assemble topical papers, some of which may be closely related to one specific region, while others will cover broader aspects. Some issues covering global LNG trading patterns, the European gas market, a view on CIS markets, and an expected development of natural gas production in China are under analysis to improve the quality of data in the final report.

SG B.2 Wholesale gas price formation study

Leader: Mike Fulwood (Nexant, UK)

During the meeting in Amsterdam SG B2 finalised the structure of the document on gas price formation which will be presented at WGC 2015. Members also identified the tasks that are still necessary to finalise the document. Three papers were discussed regarding trading liquidity and volatility of the markets, the gas/coal/renewables linkages in the power market and changing long-term contract practices. Presentations were also given on gas pricing in southeast Europe and oil indexation in contracts in Europe.

SG B.2 has contributed an article to this issue based on the 2013 wholesale gas price survey (see pages 160-163).

SG B.3 Strategy and regulation

Leader: Francisco de la Flor Garcia (Enagás, Spain)

Several topics were raised in the SG B 3 sessions and a presentation was given based on the scope of the business case. This study group is continuing the work of the last triennium by providing a complementary analysis based on a

questionnaire to which the responses have been good. At the same time the input could serve as a basis for other areas of the report.

SG B.3's study will complement the last triennium's report which was more focused on regulation, starting with a description of the regulation in each country and its impact on the strategy/business of the companies. It is important for the industry to understand the different regulations across the world in order to be able to make decisions accordingly.

There was a presentation on the investment climate facing the gas industry. The main messages with regards to the current investment climate in Europe are:

- ◆ It is not clear whether natural gas will play a transition role or a destination role in the European decarbonisation process;
- ◆ Regulators want infrastructure operators to invest but there are uncertainties with regards to the recovery of long-term investments and there is a high risk of having stranded assets;
- ◆ 2050 target: are infrastructure operators going to invest in Europe if the European Commission is saying that Europe should be gas-free by 2050?

SG B 3 has also worked on proposing examples of IOCs and NOCs where they have participated jointly or in the form of partnerships in specific projects. Based on specific examples, the group will extract common best practices across projects which were crucial for the success of these projects.

Next meeting

At press time, the next PGC B meeting was due to be hosted by Petrobras in Rio de Janeiro, Brazil, although the date had yet to be confirmed.

PGC C – Gas Markets

PGC C's fourth meeting was held jointly with WOC 1 and PGC A, and was hosted by the Korea Gas Union in Seoul, March 10-13. This was the first tripartite committee meeting since



▲ PGC C delegates at work in Seoul.

2004. The joint events have been covered in WOC 1's progress report so this report will focus on the PGC C sessions.

Twelve of PGC C's 58 members attended the meeting with the delegates coming from six countries, namely Korea, Australia, Japan, Iran, The Netherlands and Russia. In addition, there was one observer, Ross McVey (Gazprom Marketing & Trading, UK office).

The Chair, Gi Chul Jung (KOGAS, Korea), reported that PGC C and the CC Chair, Georges Liens jointly held a workshop with the title "Red Pillar – Natural Gas Available Everywhere" during the Council meeting in Beijing in October 2013. The workshop looked at the key drivers of the Chinese and Korean gas markets and the challenging issues facing them, and participants engaged in an active debate. PGC C also contributed to the Geopolitics workshop organised by TF 3 during the Beijing Council meeting – Gi Chul Jung was one of the panelists discussing the gas markets of northeast Asia and their political relevance.

SG C.1 The role of natural gas in the electricity generation mix

Leader: Alexey Biteryakov (Gazprom, Russia)
Most delegates to the Seoul meeting were members of SG C.2 as the core members of SG C.1 could not attend due to work commitments at their companies. The study group will have a separate meeting somewhere in Europe before PGC C's autumn meeting.



▲ During the gala dinner of the PGC C, WOC 1 and PGC A joint meeting delegates were entertained by the Korean musical group Queen.

SG C.2 Implications of developing unconventional gas

Leader: Shigeki Sakamoto (IAE, Japan)

Since there was no meeting for SG C.1, all delegates attended the SG C.2 meeting. The guest speaker, Ross McVey also attended and participated actively in the discussions. Maria Adilova (Gazprom, Russia) joined the Americas sub-group and was given the responsibility of covering the region of South America, while Dmitry Udalov (Gazprom, Russia) will leave PGC C due to a personnel reshuffle within Gazprom. Nak-Gyun Kim (KOGAS, Korea) confirmed he would stay in the Americas sub-group and agreed to contribute to covering Canada and Mexico. He is now required to contribute to both study groups C.1 and C.2. The Iranian delegates Mohsen Dourandish (NIGC, Iran) and Seyed Mohamad Reza Ahmadi (NIGC, Iran) agreed to give a presentation on the Iranian gas market and on-going LNG export projects during the next committee meeting to be held in London.

Shigeki Sakamoto reported on the progress of the study group's work. The report drafted on a sub-group basis that was agreed in the previous meeting is a bit behind schedule. For this reason, Sakamoto encouraged the committee members to catch up with the schedule by the next PGC C meeting.

The participants discussed the recent changes and challenging issues in regions where unconventional gas developments are underway. To summarise, there are a lot of regional differences in terms of the stage reached in developing unconventional gas. The US is the most advanced, particularly as regards shale gas, and the growth of unconventional gas production has had significant impacts (see below). The planned increase of coal-bed methane production in Australia will have a significant impact on the LNG industry, with over 20 million tons a year set to be supplied to Asian buyers. However, since current unconventional production outside North America has been relatively small, the impact on other gas markets is still limited. China may have the largest unconventional potential among them.

Various impacts of US shale gas expansion were discussed by participants. Some impacts worth noting are as follows:

- ◆ Supply of cheaper fuel to the US economy is expected to revitalise the US industries;
- ◆ New schemes of LNG pricing based on gas hub prices have been proposed;
- ◆ Pipeline gas imports from Canada have sharply decreased;
- ◆ Increase in the production of natural gas liquids has resulted in the supply of cheaper feedstock to the US chemical industries;
- ◆ Exports of US propane and ethane to South America, Europe and Asia have increased;
- ◆ Consumption of gas for power generation has been growing over the last several years – especially in 2012 – because of low gas prices;
- ◆ Decreases in coal consumption in the US have led to increases of US coal exports to Europe.

Next meeting

At press time, the next PGC C meeting was due to be hosted by Gazprom Marketing & Trading in London, UK, September 2-4.

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► PGC D's Chair, Dirk van Slooten addresses delegates during the meeting in Osaka.

Programme Committee D – LNG

PGC D's fourth meeting was hosted by Osaka Gas in Osaka, Japan, May 13-16. It was held in the Hotel Monterey Grasmere and attended by 45 delegates.

As the meeting's host, Masanori Oki (Osaka Gas), who is PGC D's Vice Chair, welcomed participants at the opening plenary session before handing over to the Chair, Dirk van Slooten (VSC Hattem, The Netherlands). Dirk reported on the CC meeting which had been held the previous month before outlining the future work schedule and deliverables. There were also presentations from Chikako Ishiguro of Osaka Gas, who looked at Japan's energy

sector post-Fukushima, and the leaders of PGC D's five study groups on the status of work so far. After the plenary session, the study groups held individual meetings to discuss their work and started drafting their reports.

In addition to the business and social sessions, there was a technical visit to the Senboku LNG import terminal where the world's largest above-ground LNG storage tank (230,000m³) is being built. The visit was followed by lunch in a traditional Japanese restaurant and a tour of Osaka Castle.

SG D.1 Remote LNG

Leader: Simon Frost (Repsol)

In general terms, remote LNG production involves sites which are far removed from any logistically developed centre, and therefore usually involve extreme conditions. These projects demand a special approach in terms of design, construction and operations. SG D.1 is evaluating the challenges and will make recommendations for future developments with LNG production greater than 3 mtpa. A "Remoteness Index" has been developed and is being further explored and analysed by the group.

In Osaka, Simon acknowledged that the individual workloads of members had limited progress so far but said that the report was 50-60% complete and welcomed a new member, Nigel Hudspith (ConocoPhillips). An additional section has been added looking at new frontiers with a focus on Alaska, Canada, Australia and East Africa. By the end of the meeting some of the chapters had been finalised and the aim is to complete the report by November.

SG D.2 LNG as fuel

Leader: Richard Lammons (Chevron, USA)

SG D.2 is carrying out a comprehensive analysis of LNG as an alternative fuel for transportation, remote power and fixed facilities in land and marine applications. The study addresses technical, regulatory

and commercial considerations. The aim is to provide valuable information and resource references to potential consumers and suppliers considering the feasibility of switching to LNG, which offers cost savings and a reduced environmental footprint.

In Osaka, members welcomed a guest from Rolls-Royce, Odd Horgren, who gave a presentation on LNG as a marine fuel, and reviewed the first draft of their report. They discussed the information gathered during the research phase and agreed that the report should be restructured by having dedicated chapters on regulations regarding emissions standards and the growth in LNG fuel applications, while the appendix on organisations and missions, end user projects and engine manufacturers should be expanded. A second draft will be ready for the next meeting and the aim is to finalise the report by January 2015.

SG D.3 Small-scale LNG

Leader: Wouter Meiring (Shell, The Netherlands)
SG D.3 is looking at the options, opportunities and challenges for LNG facilities with a capacity of less than 1 mtpa. The aim is to provide an overview of potential regions/countries of interest as well as tailor-made technical requirements/solutions. Having collected data in different geographical regions, the four sub-groups are now focusing on: drivers and busi-

ness models; safety, standards and regulations; players; and definitions and technology. SG D.3 was also responsible for a special chapter on small-scale LNG, which was included in the latest World LNG Report prepared by SG D.5.

In Osaka, members shared analysis of the data gathered, discussed the different sections of their report and started drafting them. During the next meeting a draft of the full report will be reviewed.

SG D.4 LNG life-cycle assessment

Leader: Ted Williams (American Gas Association)

SG D.4 is carrying out a life-cycle assessment (LCA) of the LNG chain which for the purposes of the report has been divided into modules covering liquefaction, transportation, regasification and end-use delivery.

SG D.4 is collaborating with the Center for LNG (CLNG) in Washington DC, USA to support data development for air emissions from LNG chain modules. CLNG will select a support contractor for data development. SG D.4 and CLNG will be developing LCA reporting separately since the work scopes and advocacy objectives being addressed by the two organisations differ. However, use of common data for LCA by these organisations should help advance the credibility of the analyses. Data development should be completed in the third

▼ PGC D delegates pose for a group shot before enjoying their welcome buffet.



quarter of 2014. SG D.4 is also coordinating its LCA efforts with SG A.3, which is conducting LCA for the broader natural gas chain and including natural gas production, transport and end use.

In Osaka, members developed a detailed outline of their report and assigned work on the chapter writing, graphics, data archive and modelling template. This work will proceed while data development support arrangements are finalised and data development is under-way. The SG D.4 report will follow IGU's advocacy messaging in the presentation of data and analysis. It will also be consistent with IGU's World LNG Report and other industry work on LCA.

SG D.5 Annual World LNG Report

Leader: Philippe Corbière (Total, France)

IGU's World LNG Report provides up-to-date information on LNG liquefaction plants, carriers and regasification terminals and is an important reference document for the industry. SG D.5 is responsible for producing three reports during the current triennium and is working with consultants PFC Energy.

The latest edition was published at the end of March and was well received. It includes a

section on retail LNG as well a special report on small-scale LNG. (See pages 142-148 for an edited version of the small-scale LNG report.)

The 2015 edition will be published in the run-up to WGC 2015 and the shipping section will be expanded thanks to new members from RasGas and SIGTTO. It will also include a focus on each study group's work during the triennium.

Next meeting

At press time, PGC D's next meeting was due to be hosted by the Malaysian Gas Association in Kuala Lumpur, Malaysia, September 22-25.

Programme Committee E – Marketing and Communication

Chaired by Alfredo Ingelmo Torres (Sedigas, Spain), PGC E has two objectives. On the one hand, it seeks to identify and develop ideas, tools and products in order to successfully promote and sell natural gas. On the other, it seeks to define ways to effectively convey the merits of natural gas and its role in sustainable development, and in a clean economy.

PGC E's membership is still growing and has reached 66 nominated members of which 23 attended the fourth meeting. This was hosted by RasGas in Doha, Qatar, March 3-5

▼ Delegates to PGC E's fourth meeting in Doha pose for their group photo.



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▲ Seen from left to right during PGC E's fourth meeting are David Konvalina, Hansch van der Velden, Laura Young and Barbara Jinks.

SG E.1 Marketing natural gas and promoting new usages

Leader: Luis Pinto (Shell, The Netherlands)
SG E.1 met in Doha to discuss the survey and work plan going forward, including preparations for the panel discussion that will be held during WGC 2015. This session will highlight the best practices of individual companies, industries and countries in their successful promotion of alternative uses of gas, and find ways to replicate them in other markets.

The next steps are to continue analysing feedback from the survey on alternative uses for gas, and to try and get more responses from Asia and other members of PGC E. There will also be analysis of global marketing campaigns within and outside the industry to gauge their effectiveness and success in order to present this information during the WGC panel. Data is being distilled for presentations and the final report for which SG E.2 has selected two case studies: France (multiple uses of gas in the residential sector) and clean coal (rebranding of coal in the US). One more case study is being considered on alternative uses for gas.

SG E.2 Competing and coordinating with other energies

Leader: Barbara Jinks (Gas industry advisor, Australia)

SG E.2 is pursuing the following objectives:

- ◆ Encourage the audience to learn new ways of being effective in communicating the gas message;

- ◆ Inform the audience of what other industries are doing to communicate their message more effectively than the gas industry;
- ◆ Learn from speakers in the gas industry who will outline ways of being effective in communicating the gas message. In addition, proven marketing tools and strategies used by other industries will be analysed;
- ◆ Speakers are encouraged to present in engaging ways including the use of graphics or videos and interacting with the audience.

The content of the work being developed includes results from global leadership and internal communications surveys, the presentation of case studies of gas marketing campaigns and the presentation of examples of effective marketing campaigns by other industries.

Members of the group have been sharing information and skills with each other through the development of case studies where companies have developed unique methods of communicating their message. These include equipping internal employees with knowledge and tools to promote natural gas, managing stakeholder relations and using the internet in smarter ways.

SG E.3 Communication and public acceptance of natural gas projects

Leader: Hansch van der Velden (Gasunie, The Netherlands)

SG E.3 promotes knowledge sharing and debate on public acceptance. Last year, its leader, Hansch van der Velden was the moderator of the 17th European Gas Conference in Oslo, where public acceptance was a key theme. He also spoke at the European Autumn Gas Conference while member, Dimitri Schildmeijer (WPNT, Belgium) gave a speech on public acceptance at the Sedigas 2013 annual meeting in Madrid. Earlier the group had published an article in *Natural Gas & Electricity* entitled "Golden Age of Gas? Not in My Backyard" (December 2012, see <http://db.tt/npoEil3t>). This year SG E.3 prepared

a keynote speech and a workshop on public acceptance for IGRC2014.

The group will present a report with recommendations for IGU in a WGC 2015 thematic session on June 2. The report will outline a model for public acceptance and lessons learned from case studies in Europe, South Africa, Australia, the USA and elsewhere.

Finally, SG E.3 advises and supports the IGU Secretariat in its ambition to become a more active voice in the global gas debate. The group acts as a soundboard for the development of a new global gas portal and IGU's advocacy and communications strategy.

i-gas Industry: Contribution to a special report

Leader: David Konvalina (RWE Transgas, Czech Republic)

All study groups are covering this transversal topic looking at the impact of online and digital media on the gas industry. PGC E also aims to continue work on the 2011 "IGU Online Proposal" report produced by SG E.3 in the previous triennium.

Next meeting

PGC E's next meeting will be hosted by Gasunie in Rotterdam, The Netherlands, September 29-October 1.

Programme Committee F – R&D and Innovation

Advances and innovation continue across all facets of the gas industry from production through utilisation. PGC F encourages and promotes information exchange and collaboration in global gas research, technology transfer and emerging technology and innovation.

The development and implementation of technology is a foundational element across the spectrum of the gas industry – from the substantial growth in global shale exploration and production, to the extension and rehabilitation of the world's gas pipeline infrastructure, and to the development and implementation of new applications in energy utilisation. Each of the value-chain segments of the gas industry are built from substantial investment and application of technology and innovation.

To address key gas research and innovation topics in the industry, PGC F is progressing with three study groups under the chairmanship of Dr Jack Lewnard (Chesapeake Utilities, USA). The committee's fourth meeting was hosted by Sonatrach in Oran, Algeria, March 10-11. At press time, the next meeting was due to be held in Copenhagen, Denmark, immediately following IGRC2014 on September 19.

▼ Delegates to PGC F's fourth meeting in Oran pose for their group photo.





▲ PGC F delegates were taken on a technical visit to Sonatrach's LNG plants in Arzew near Oran.

SG F.1 Technical Programme for the IGU Research Conference (IGRC2014)

SG F.1 worked diligently to develop the programme topics and priorities, as well as review the submitted abstracts for IGRC2014. More than 750 abstracts were submitted during the call for papers period and the conference programme comprised of top ranked selections from the submitted abstracts as well as invited keynote speakers. The final programme included more than 400 papers from 38 countries representing all the regions of the world. Papers were due to be presented in 20 oral sessions, eight workshop sessions and 10 poster sessions covering innovations, technologies and best practices for the entire gas chain from well head to burner tip.

SG F.1 was responsible for setting the structure of the conference; issuing the call for papers; selecting papers and speakers for technical sessions and workshops; and administering awards including the Young Researcher Prize and the Dan Dolenc Best Paper Prize. The study group drew across the expertise of the entire PGC F committee as well as external experts to define the programme structure and compelling, high-interest topics from the record number of abstracts submitted. There will be a full report on IGRC2014 in the next issue of the IGU magazine.

SG F.2 Development of international gas RD&D collaborative programmes

As technology advances, there is a continued need within the gas industry for more effective information dissemination and collaboration in research, development and innovation. Particularly in light of decreasing resources allocated towards R&D activities, there is an increased need to identify and promote collaboration and cost-savings opportunities amongst the global gas industry research community. SG F.2 is addressing this need through the development of a global database of current R&D facilities and programmes. The initial task is developing an inventory of global R&D programmes and facilities to establish a baseline level. Follow-on tasks investigate business models for gas R&D in terms of short- and long-term drivers, and the intrinsic value from research and technology investments. Deliverables will include a database of natural gas R&D facilities, capabilities and programmes as well as frameworks for inter-company and international cooperation.

SG F.3 Convergence of gas with electric and renewable energy

SG F.3 has been working to identify and characterise new business models that anchor natural gas as part of the future energy mix. Examples include scenarios with gas augmentation of renewable geothermal and solar energy for heating and cooling loads, or as back-up for intermittent electricity production from renewable sources. The gas grid also has enormous potential to provide energy storage. Given these scenarios, the gas infrastructure becomes critical for integrated energy grids that holistically manage electricity and thermal loads. SG F.3 is working on specific tasks that include identification of innovative technology and business models to maximise the value of gas and integration, and the relationship with renewable power and electric distribution systems.

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Progress Reports from the Task Forces

This chapter contains news and information from two of IGU's three Task Forces. TF 2 – Gas Advocacy will not meet again until December and will report in the next issue.

Task Force 1 – Human Capital

Chaired by Agnès Grimont (GDF Suez, France), TF 1's fourth meeting took place in Muscat, Oman on March 5. It was hosted by Oman LNG, whose CEO, Harib Al Kitani, gave a welcome speech. Oman LNG executives, Mansour Al Alawi and Mahmood Al Hadidi, then gave presentations on the LNG market and talent management best practices, respectively. Edited versions of these presentations have been posted on the Growing Together collaboration platform.

Progress on the human capital survey

TF 1's Vice Chair, Abdulaziz Mohammed Al-Mannai (Qatargas) and Marius Popescu (Energy Brains Consulting, Romania) presented an overview of progress on the company survey, interviews and collection of best

practices since the previous meeting in Paris in December 2013.

In Paris a target of 100 replies to the company survey was set (200 companies had been approached) and each TF 1 member was asked to help chase replies, conduct interviews and invite contributions on best practices. At the time of the Muscat meeting there were 75 replies to the company survey from 32 countries across six continents, while 75 interviews had been conducted in 29 companies: 24 with senior executives, 12 with HR executives, 22 with female professionals and 17 with young professionals. Five answers had been received on best practices from Australia, the Czech Republic, Qatar, Tunisia and the USA and others are awaited, particularly from Canada and France.

After the presentation, members agreed four action points: the other technical committees and task forces will be asked to help carry out interviews and ask about best practices; some TF 1 members will be nominated to join the meetings of other technical committees and task forces; Oman LNG will launch the survey to its partners; and the survey will be put online via the collaboration platform so that it can be completed easily.

Progress on the WGC 2015 Youth Programme

Marc Mopty (GDF Suez, France) gave the latest details on planning of the Youth Programme, which will start on the Tuesday afternoon (June 2, 2015) and end on the Friday afternoon (June 5).

The Youth Programme will take place in Pavilion 2 of the Porte de Versailles Convention Centre with 400m² of dedicated space and

▼ TF 1's fourth meeting was hosted by Oman LNG in Muscat.





◀ Delegates to TF 1's fourth meeting pose for a group photo with their Chair, Agnès Grimont at the centre of the back row.

additional use of the Montmartre suite (240m²) at certain times. The layout of the space is being designed in close collaboration with the conference organiser, Elephant Group, and particular attention is being paid to how to organise the space beside the networking area to encourage interaction with other delegates.

Youth activities will aim to bring together people at different stages in their careers to provide the next generation with a comprehensive view of the gas industry. There will be conference and workshop sessions which will be scheduled to allow delegates to attend the WGC keynote sessions and have free time to visit the exhibition. Each delegate will be able to choose the workshop they wish to attend and breaks will allow ample opportunity for networking. There will also be evening social events.

A highlight of the programme will be a one-day "Arctic Drilling Battle" and there will also be participation in the strategic panel "Women's place in the gas industry" and

thematic session "Battle for talent" being organised by TF 1 (see below).

Alberto Ortega Cabezon (GDF Suez, France) is in charge of the marketing and logistics of the Youth Programme.

Progress on the WGC 2015 sessions

TF 1 is organising the special panel "Human capital strategy for the future" which will present the results of the human capital survey in order to understand the key drivers of human resources within the industry and share best practices.

TF 1's thematic session "Battle for talent" will look at how to promote STEM (science, technology, engineering and mathematics) education and get young people interested in STEM subjects. There will be a panel with representatives from educational establishments, UNESCO and industry, with members asked to prepare personal testimonies. These will be complemented by videos of young people being asked if they would like to study

► A working meeting between Gazprom and CNPC in Moscow – TF 3's workshop will look at Russia's energy relationships with China and the EU.



STEM and why. Consideration is also being given to the participation of media representatives and other organisations (such as the City of Science and Industry in Paris), who have experience in science promotion.

The strategic panel "Women's place in the gas industry" will seek to understand the factors that discourage women from entering the engineering workforce and examine what national and company policies could increase their participation. As an introduction there will be portraits of female engineers and role models. Then there will be roundtables of CEOs from France (Total), Pakistan and Qatar and ministers (of education for instance) from Oman, Egypt and Morocco.

Next meeting

TF 1's next meeting will take place in St Petersburg, Russia, October 7-8.

Task Force 3 – Geopolitics

Chaired by Geert Greving (GasTerra, The Netherlands), TF 3's second meeting was hosted by Eni at its headquarters in Rome, Italy on July 10. During the meeting, experts from the Dutch and French think-tanks CIEP (Clingendael International Energy Programme) and IFRI (Institut Français des Relations Inter-

nationales) outlined the studies to be presented at WGC 2015. In Rome, members built further on the "The New Geopolitics of Gas" paper first discussed with the experts in Paris, France in February 2013.

The proposal to carry out one smaller main study and three topical studies was welcomed by members and there was a fruitful discussion of the topics identified. The main study will continue to build on the report written in the last triennium, but will put greater emphasis on the different actors defining the geopolitical landscape. This approach will also be followed in the three topical papers: border disputes, good governance and the backlash to the green image of natural gas.

At press time, TF 3, in collaboration with the International Peace Institute, was due to host a meeting on Energy and Security in West Africa in Paris on September 9. The focus of this meeting was the link between energy policy and stability in this region.

Please note that during the IGU meetings in Berlin, TF 3 will organise a workshop on geopolitics open to all delegates. The theme will be the EU-Russia-China energy relationship: The impact of a connected gas grid from Lisbon to Beijing. We hope to be able to welcome you to this workshop on Wednesday, October 15.

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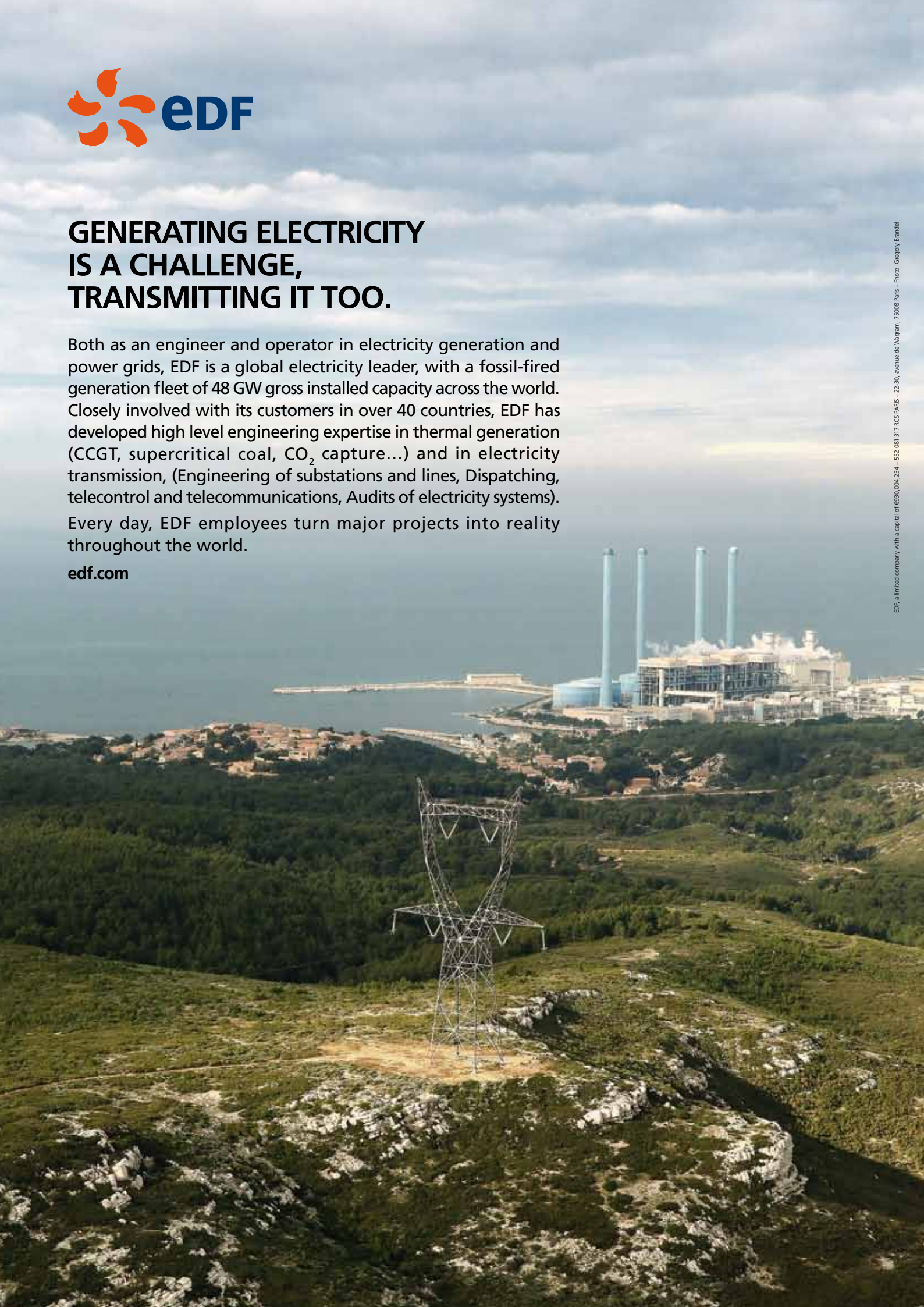




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Features

This issue's features section starts with an overview of the gas industry in Germany, which is hosting the 2014 Council meeting in Berlin.

Next up are an article from WOC 4 on smart gas grids, a Q&A with Bjørn Håmsø, Manager of the Global Gas Flaring Reduction Partnership, articles on small-scale and floating LNG and a report on IGU's wholesale gas price survey.

Then we have an article from WOC 2 looking at how the UGS sector can help with the storage of surplus energy generated by renewables, and a look at gas developments in the Arctic.

We round up with a description of the publications and documents available from the Secretariat and the events calendar.

New Technologies for Gas Production

By Sherif Foda, President, Schlumberger Production Group

Oil and gas operators in unconventional plays continuously strive to stimulate more perforations and longer intervals, complete wells faster and more efficiently, and increase production while lowering costs and non-productive time (NPT). In many wells, however, it is still difficult to optimise the stimulation of perforation clusters and open hole intervals using conventional techniques.

Earlier this year, Schlumberger introduced the new BroadBand Sequence* fracturing technique to the industry. This new technique can reliably isolate perforation clusters and ensure that every cluster along the lateral contributes to production. Sequenced stimulation treatments alternate multiple stages of proppant with pills of a specially engineered composite fluid consisting of degradable fibres and multiple-sized particles. As a result, operators can effectively stimulate more clusters per interval, and treat longer intervals without requiring additional bridge plugs. By reducing the number of bridge plugs per completion, it saves both operational time and costs.

Sequenced fracturing is applicable for both new wells and recompletions. Since it does not require mechanical devices to isolate clusters, the technique is ideal for refracturing and stimulation operations in wells with troubled completions: deformed or stuck casing, or misfired perforations.

This new technique has been applied successfully in more than 1,000 unconventional shale operations as well as tight sandstones and carbonates, reducing NPT and boosting production. For example, operators in South Texas have increased production from new completions in unconventional reservoirs by more than 20%. In one South Texas refracturing operation, the BroadBand Sequence fracturing technique quadrupled the flow pressure and doubled gas production. Well completion times have been reduced as much as 46% in plug-and-perf operations by stimulating longer intervals than conventional methods.

Doing More with Less

Another technology that advances gas production is the HiWAY* flow-channel hydraulic fracturing technique, which significantly increases fracture conductivity while reducing water and proppant consumption. This means higher short- and long-term production, simpler logistics, and a smaller operational footprint.

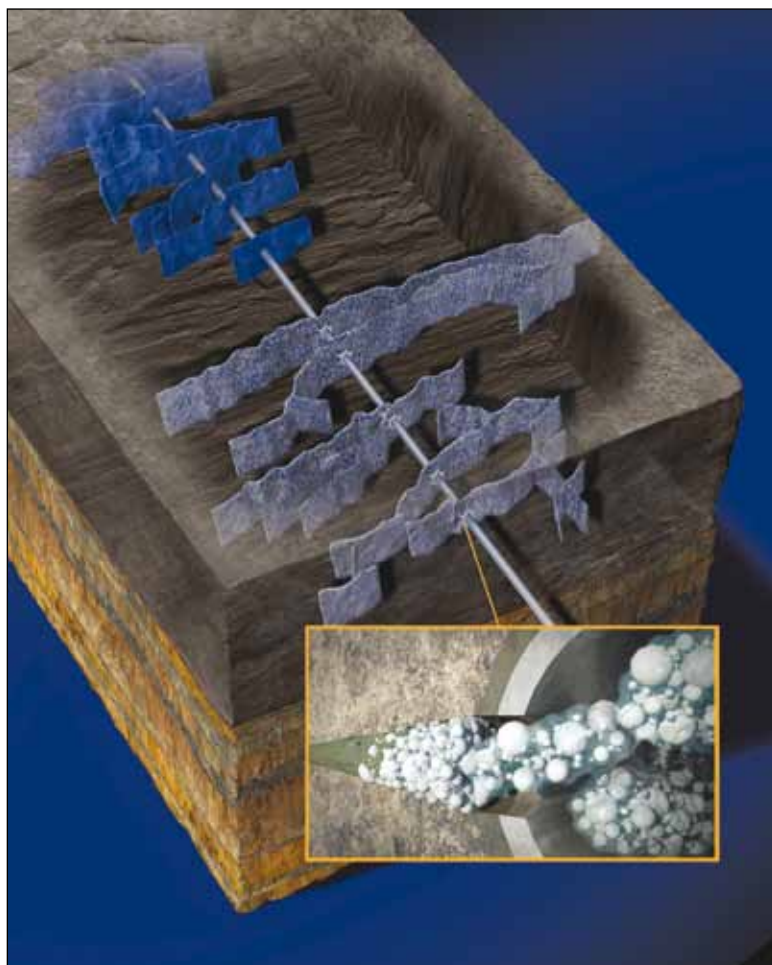
The HiWAY technique fundamentally changes the way proppant fractures generate conductivity. The first of its kind, the HiWAY technique creates open pathways inside the fracture, enabling hydrocarbons to flow through the stable channels rather than the proppant. This optimises connectivity between the reservoir and the wellbore—resulting in infinite fracture conductivity.

In the Haynesville shale, an operator wanted to reduce operational footprint and

simplify logistics while improving well productivity. The operator and Schlumberger applied the HiWAY technique on two wells with similar completion parameters as five offset wells completed conventionally. On average, the HiWAY wells used 47% less proppant and 26% less water than offset conventional wells. After two years in production, wells treated with the HiWAY technique produced 25% more normalised gas than offset wells.

In South Texas, a field study comprising 523 horizontal gas wells completed with conventional fracturing methods and 89 horizontal gas wells completed with the HiWAY technique showed a 41% improvement in cumulative production over 12 months for wells in which this technique was applied.

*Mark of Schlumberger



The BroadBand Sequence fracturing technique enables sequential stimulation of perforation clusters, resulting in greater production from investment.



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Schlumberger

Germany Hosts the 2014 Council Meeting

By Georgia Lewis

The IGU Council last convened in Germany in 1991, nine months after unification, when momentous changes were sweeping eastern Europe. As delegates return to Berlin for the 2014 event their attention is once again focused eastwards – this time on the Ukrainian crisis and its long-term implications.

Only 10% of Germany's natural gas demand is met by domestic production which is declining as proved reserves are depleted. BEB Erdgas und Erdöl, which is owned 50:50 by ExxonMobil and Shell, is the country's

main gas producer followed by RWE, Wintershall and GDF Suez. Gas production is centred on the state of Lower Saxony, although there is a North Sea field. Lower Saxony and the neighbouring state of North Rhine-Westphalia are the most promising regions for shale gas exploration.

Germany imports gas via pipeline from The Netherlands (23% of imports in 2013), Norway (35%) and Russia (42%) and is an important transit hub. It does not have LNG receiving capacity as neither E.ON nor RWE could make the numbers add up for a proposed terminal in Wilhelmshaven, although the project may be re-evaluated on security of supply grounds. In the meantime, German companies have access to foreign capacity. E.ON, for example, has a contract with Gate LNG in Rotterdam. Imports are handled by Bayerngas, E.ON, ExxonMobil, RWE, Shell Deutschland, Verbundnetz Gas and W&G, a joint venture of Wintershall and Gazprom.

Germany has a well-diversified and flexible natural gas supply infrastructure with gas accounting for 23% of the country's primary energy consumption. It is the number three energy source after oil (34.5%) and coal (25%). Under the Energiewende policy, Germany is restructuring and decarbonising its energy sector by phasing out nuclear power (the number five energy source at 6.8%) and increasing the share of renewables (currently 9%). Gas has an important role to play in backing up renewables but low coal and carbon prices are a challenge, as is a moratorium on hydraulic fracturing for shale gas.

▼ Germany has one offshore gas field – A6/B4 on the German continental shelf of the North Sea. Production started in 2000.



Fracking debate

The German gas industry is at an interesting juncture as the seven-year moratorium on shale gas fracking, while welcomed by environmental groups, could slow down any attempts to reduce Germany's reliance on imports.

The moratorium was announced on July 4 by Barbara Hendricks, the Federal Environment Minister, and Sigmar Gabriel, the Economic Affairs and Energy Minister, with legislation expected in early 2015. It applies to shale gas fracking for drilling operations shallower than 3,000m and will be reassessed in 2021.

While fracking proponents say shale gas production would boost the German economy and create thousands of jobs, fears about contamination of drinking water have led to the moratorium. Indeed, the Deutscher Brauer-Bund (German Brewers Federation) was one of

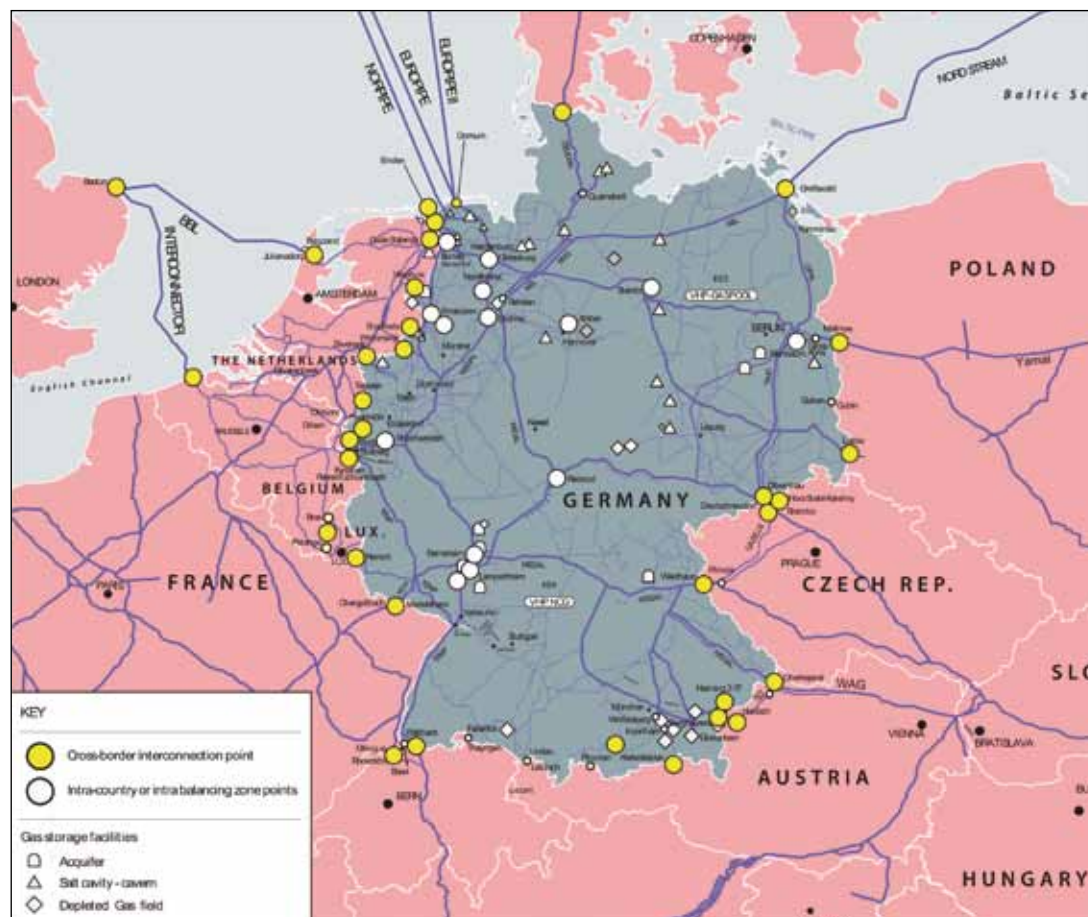
Germany's Gas Industry 2013 (bcm)

Gas consumption	83.6
Gas production	8.2
Gas imports	95.8
Gas re-exports	19 (approx.)
Gas storage capacity	20 (approx.)

Source: BP Statistical Review of World Energy 2014

the bodies involved in a major lobbying campaign to ban fracking.

However, there are dissenting voices within the German establishment. Günther Oettinger, a member of Chancellor Angela Merkel's Christian Democratic Union party and EU Energy Commissioner, told *BZ am Sonntag* newspaper that, given other EU states such as Poland and the UK are willing to exploit shale



Germany's major gas pipeline connections and storage facilities.

► Fracking has been used in tight gas formations in Germany since the 1950s.



gas, Germany should keep its options open in this regard. Mr Oettinger told the paper that Europe could potentially secure around 10% of its gas needs via shale gas in the long term and it would help Europe rely less on energy imports from Russia.

▼ ExxonMobil's drill core archive in Nienhagen, Lower Saxony.

Before the July announcement on shale gas fracking, multiple reports had been compiled, particularly in regard to the safety and

regulatory requirements, with some variations in the conclusions.

Tight gas fracking has taken place in Germany since the 1950s (although the issue of new fracking permits was suspended in Lower Saxony in 2012) and the country has made important contributions to the development of the technology. In 1995, for example, a depth record was set for a combination of horizontal drilling and multi-stage fracking in the 4,800m-deep Söhlingen Z10 well. The 2012 annual report of LBEG, Germany's State Authority for Mining, Energy and Geology concluded that "there has been no known environmental damage during all these years".

Additionally, ExxonMobil conducted a study in 2011 on the potential risks and environmental impact of unconventional gas production in Germany, the results of which were presented in April 2012. There were two main conclusions drawn by the scientists in the *Risikostudie Fracking* report. Firstly, they concluded that hydraulic fracturing, in comparison to conventional gas extraction, comes with a "new range of risks" because of an increased number of wells, increased water





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consumption, the use of chemicals and heavier traffic. However, the second conclusion was that “slow and cautious development of hydraulic fracturing in unconventional reservoirs should be possible” and that there is “no factual reason for a ban of the technology”.

Studies conducted by Germany’s Federal Ministry for the Environment and the Ministries of the Environment and Economy of North Rhine-Westphalia in 2012 offered cautious support. The federal study concluded that fracking should not be banned but should only take place in an environment of strict regulation and strong administrative and scientific supervision. The North Rhine-Westphalia study made more cautious recommendations such as suspending shale gas activities in the state until safer fracturing fluids are available and improvements are made to waste disposal.

However, the German Advisory Council on the Environment (SRU) concluded in May 2013 that in current conditions, shale gas production in Germany is “dispensable” and, in accordance with current scientific knowledge, there are still unanswered questions regarding the risks involved. The SRU recommended that questions about the risks of fracking be systematically

clarified and for permits to only be issued for pilot projects in the meantime.

Three German institutes for geology and environment, the Institute of Geosciences and Natural Resources, the German Research Centre for Geosciences and the Helmholtz Centre for Environmental Research published the “Hanover Declaration” on the topic of environmentally compatible hydraulic fracturing in August 2013. This report concluded that natural gas is an “indispensable” resource for Germany and extracting shale gas could help to stabilise resources. The report also recommended environmentally friendly procedures and a better-developed regulatory framework for exploration and production, with protection of drinking water and the effect on groundwater quality as the top priorities.

Gas developments

While the government’s announcement means German shale gas production is off the agenda for the medium term, there are still opportunities for the country’s gas industry.

Gas is already an important fuel for road transport in Germany with more than 920 CNG/LNG fuelling stations and 100,000 NGVs in use.

► The German government offers generous incentives to develop renewable energy sources – installing an offshore substation at E.ON’s Amrumbank West wind farm.



Energy turns the world around

Every country faces pressure from voters who want clean and affordable energy to power their lives. This is a challenge to any nation, in particular those heavily dependent on coal.

In its *Energy Technology Perspectives 2014*, the IEA says gas-fired power generation supports two developments towards a cleaner energy system: integration of renewables and displacement of coal-fired power generation¹. Put another way, natural gas helps maintain security of supply while limiting carbonisation of the atmosphere.

¹ www.iea.org/publications/freepublications/publication/EnergyTechnologyPerspectives_ES.pdf (Page 5, final paragraph)

Coal is in decline. Even though demand for coal is growing, investors have limited confidence in the future prospects of coal. Since 2011 the stock market price of Peabody Energy – a company heavily exposed towards coal – has fallen by 75%². In the same period, the S&P-500 index rose by 40%.

Our shareholding companies, municipal energy companies in Germany, Switzerland and Austria, are prepared. They invest in the upstream E&P business in order to secure self-sufficiency in low-carbon energy supply, and thus reduce reliance on other, more unpredictable suppliers. In times of political

² www.peabodyenergy.com/content/318/Shareholder-Information/Stock-Quote

unrest and uncertainty, our shareholding companies will enjoy a stable and secure supply of natural gas through Bayerngas Norge. Our mission is to bring energy to Europe.

By 2025, Munich will produce enough green, renewable electricity to meet the demand of its more than one million inhabitants. Stadtwerke München, a German utility provider and majority shareholder of Bayerngas Norge, ensures security of supply to Munich by offering a stable supply of natural gas from Norway. This helps support Munich's transition toward being an environmentally friendly city.

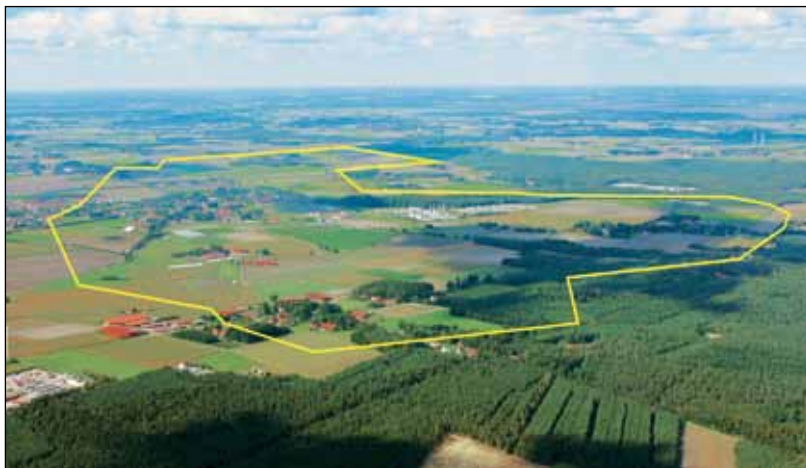
6 fields in production



3 fields under development



▼ W&G subsidiary Astora operates Germany's largest gas storage facility in Rehden with a capacity of 4.2 bcm. The extent of the underground volume is shown by the yellow outline.



Now LNG is being adopted as a marine fuel. This is driven by new emissions standards for marine engines which come into effect in January 2015 and which are particularly stringent in the Baltic and North Seas.

Bomin Linde LNG is building LNG bunkering terminals in Hamburg and Bremerhaven which will also serve neighbouring ports, such as Kiel, Lübeck, Rostock and Wilhelmshaven. Meanwhile, Brunsbüttel Port at the junction of the River Elbe and the Kiel Canal is planning to provide LNG bunkering in cooperation with Gasnor. Germany is also involved in the European Union's LNG masterplan for inland ports along the Rhine-Meuse-Main-Danube waterway.

These and other developments will be presented to Council delegates during a special session looking at the challenges and opportunities for the German gas industry.

Georgia Lewis is the Managing Editor of International Systems and Communications.

A Rich Gas Heritage

The German gas industry has a long history with the first small-scale gas installation in 1816. Gas street lights were installed in Hanover in 1826 using British technology (George IV of Britain was also the King of

Hanover). The first German-built gas plant opened in Dresden in 1828.

In 1859, the Verein Deutscher Gasfachmänner und Bevollmächtigter Deutscher Gas Anstalten was established and after several name changes

it became today's Deutscher Verein des Gas- und Wasserfaches (DVGW), the German Charter Member of IGU.

Germany was a founding member of IGU and in June 1931 Karl Lempelius represented Germany at the first IGU Council meeting in London. The first German IGU President, Hermann Müller was elected in 1937, but the outbreak of World War II meant the work of the 1937-40 Triennium was not completed.

After the post-war division of Germany, the Federal Republic joined IGU in 1951 and the Democratic Republic in 1970. The Federal Republic held the presidency from 1964-67 and again from 1982-85, and the Democratic Republic was elected for 1988-91. With the unification of Germany in 1990, DVGW became the sole Charter Member and the 18th World Gas Conference was held in Berlin in 1991.



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2-5 June 2015



Towards Smart Gas Grids

By Pascal Vercamer
and Ben Lambregts

Traditional gas grids are demand-driven, passive networks, while the energy systems of the future will need active networks with interactive functionalities. Working Committee 4 (WOC 4) has set up a study group to look at “smart” gas grids and their potential to improve gas distribution network design, operation and performance.

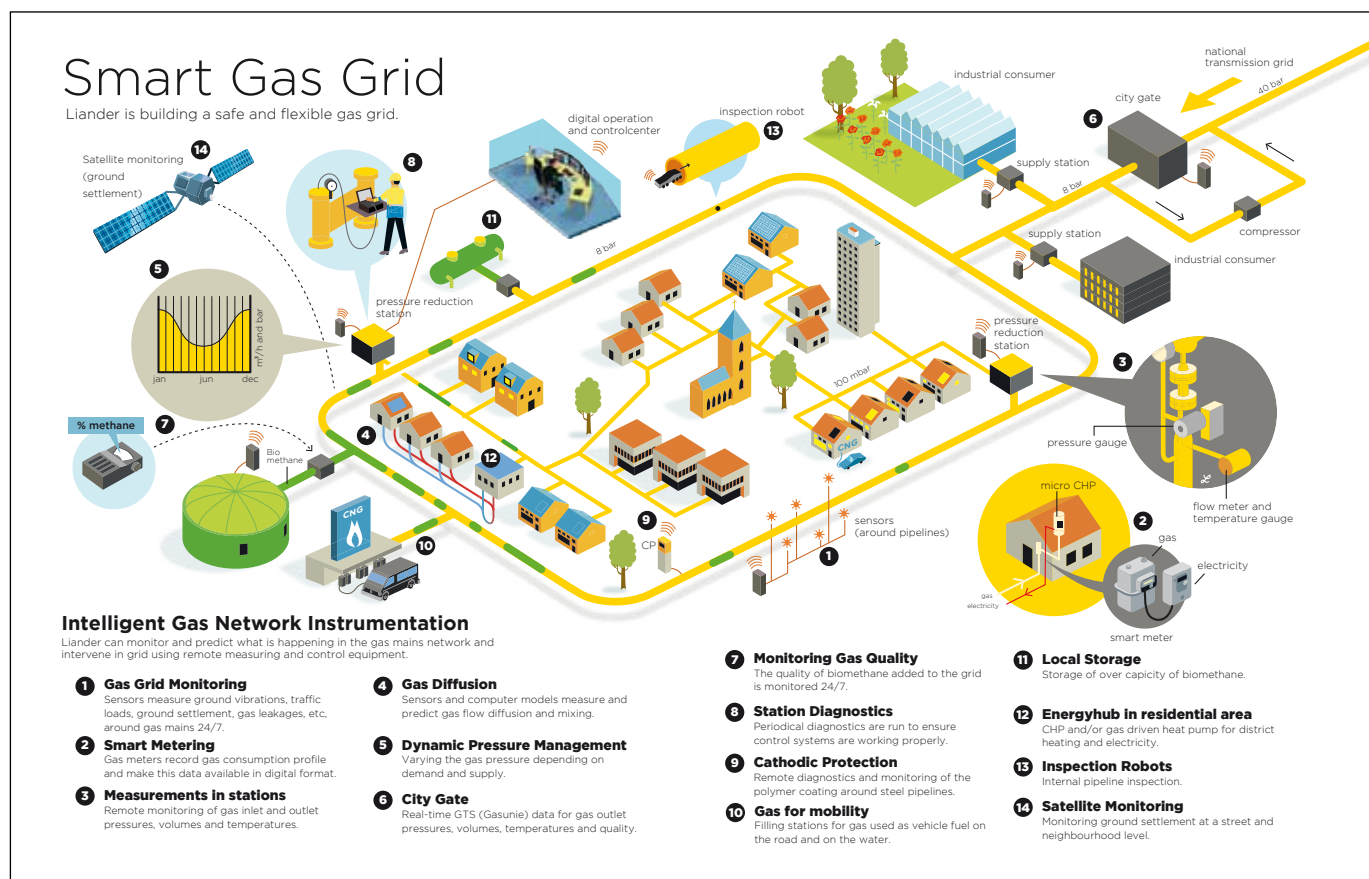
A smart gas grid is one that is fully remote-controlled and, in its ultimate form, operates and adjusts autonomously (see Figure 1). It is made possible by technological innovations that offer cheap, reliable and efficient solutions for sensors, remote control and real-time

simulation of gas flows. Transforming a grid from a passive to an active one meets an increased need for transparency and accountability, allows customers to be provided with an integrated energy supply and offers greater safety and reliability.

Transparency and accountability

An important area where increased transparency is required is that of costs. Supervising authorities and shareholders require more justification of the costs claimed by network operators subject to the control of energy

▼ Figure 1.



regulators. Moreover, network operators will have to reduce their costs as the amount of gas transported through their grids as well as the number of customers decrease due to energy savings and the switch to sustainable energy sources. Thus the efficiency of gas grid operations has to improve. For this, network operators need to understand all the stresses and flows on the network and to be fully aware of the conditions of the network in all possible scenarios in order to be able to make real-time adjustments on the basis of an appropriate set of sensors. Automatic and remote control allow costs to be cut in a responsible way without compromising safety and reliability.

It must be noted that smart gas grids can be developed independently of a complete roll-out of smart gas meters. However, when smart gas meters are used they can offer additional benefits and services to stakeholders including consumers. An important advantage for the network operator is the possibility of a better diagnosis of loss of gases from the grid with consequent financial and environmental benefits. Operators can use pressure control to reduce the pressure in the network to its lowest required value and minimise any leakage. Additionally, operators can reduce administrative losses by analysing flow and pressure measurements in the network and data from customers' gas meters. The development of remote metering or smart metering is a promising way to provide a frequent and accurate analysis of gas inputs and outputs to and from the network in order to identify the sections with losses or possible defaulting meters.

Multi-gas future

In many countries, gases are provided from different sources with different qualities, while local biomethane injection is becoming more frequent. The specific quality of biomethane can be different from that of the natural gas supplied from the transmission grid and its quality can vary over time.

In such a multi-gas future, it is expected that distribution network operators will not upgrade all the distributed gas to a common quality, but will need to accept a broader range of qualities. Appliances will deal autonomously with larger variations in gas quality and networks will be engineered to cope with the offered variety of gases. We envision a future where networks with different gas qualities are connected and gas flows are actively controlled and mixed to ensure a suitable quality in specific regions and for specific end users. This situation will also necessitate a new way for calculating the energy consumption for billing the final customers.

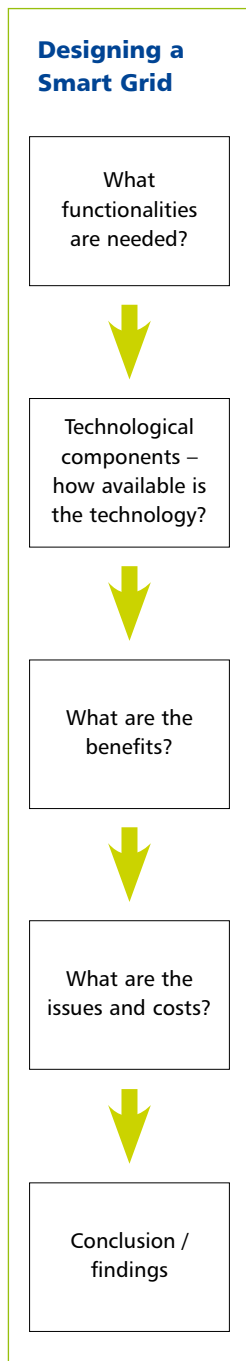
There will be a need to balance supply and demand, which is more complex with the input of biomethane or synthetic gas for gas networks and the input of decentralised production for electricity networks. Balancing will be easier if the different networks are coupled together. For gas grids, this calls for systems in which pressures and flows can be controlled and in which the composition of the gas at each point is known with accuracy.

The future smart gas grid will include, or at least accommodate, gas storage, gas conversion and mixing systems, in order to facilitate the use of new and sustainable gas sources.

Integrated energy systems

A key feature of gas grids is their ability to store energy. This storage provides flexibility in the use of gas between day and night and seasons, and flexibility in relation to the production of other types of energy (e.g. electricity, heating and cooling). In addition to the provision of discrete storage of energy in dedicated facilities, the gas network itself may be used to store energy (by cycling of pressure in the network) when gas is not directly consumed.

Smart gas grids cannot be developed in isolation but should be linked to future smart electricity grids and should facilitate smart energy utilisation, e.g. in cogeneration (combined heat and power – CHP), heating and cooling.



▲ Figure 2.

However, electricity networks require real-time responses to changes in demand as electricity cannot easily be stored. Therefore, there are large benefits for the electricity industry to adapt tariffs for managing peak instantaneous demand. Gas networks and / or heating or cooling systems could be used as a buffer to limit gas delivery peaks (filling of CNG tanks for example) or to reduce the peaks on the electricity network. Residential gas appliances are mainly used to provide heating and hot water, which are basic needs (cooking, hot water and minimum temperature). There is limited scope to reduce energy consumption in these areas; any reductions will be dependent on improvements in appliance efficiency and / or on increases in the level of insulation in the home, the consumer having no short-term influence on factors such as external temperature and humidity. By contrast, the diverse electrical appliances provide numerous opportunities for consumers to decrease their electricity consumption and manage their peak energy demand.

Smart gas grids change the way in which energy is provided to the end user and adapted to his needs. It is doubtful whether by 2050 all households will be connected to the gas distribution system. Perhaps the network will focus on industrial and business clients, transportation and (small) district heating systems. Besides decentralised electricity (especially solar and wind) and decentralised gas (biogas, biomethane and synthetic methane), decentralised heat (locally produced or waste heat) will also play an important role. Supply and demand will not match and there will be a need for short- and long-term balancing and storage that supplement the decentralised energy sources. This requires a flexible energy system with a potentially important role for the gas network.

In the integrated energy system many consumers will also be producers (they should perhaps be called “prosumers”). For that role as prosumers, they will need up-to-date and timely data about energy supply and demand –

not only (national) market data, but also information about local and regional distribution capacity. The role of the grid operator will include the new task of providing the necessary data. This makes the roll-out of smart gas and electricity meters relevant. The data from smart meters can be used for a variety of new services to the market in which the grid company can play the role of data broker.

In such an integrated energy system smart metering is even more relevant than in the case of separate electricity, gas and heating networks. For network operators, smart meters provide an opportunity to obtain data on performance and energy flows in the combined networks.

Benefits for safety and reliability

Gas distribution grids are very safe compared with other ways energy is transported. But falling social acceptance of accidents and perceived risks means that operators are increasingly held accountable for any problem associated with their networks. They must thus work to enhance safety and reduce the risks to employees and the public by developing real-time surveillance and monitoring of gas networks.

In a world where interactivity is the rule, the ability to react quickly in case of an incident will be a greater requirement of the administration in charge of public safety. This is a challenge which will be important for the network operators of the future.

Questions about smart gas grids

For network operators, elaborating a roadmap for the design and construction of smart gas grids starts with the choice of functionalities which in turn determine the technologies that have to be implemented on the network. These must be challenged in terms of performance and economics. The process can be presented in a graphic (see Figure 2).

The functionalities must be defined by answering different questions:

- ◆ What interaction is there between electricity, gas, heat and cooling?
- ◆ In terms of planning future investments are new networks or renovation of existing networks envisaged?
- ◆ What smart / combined energy utilisation will there be (e.g. cogeneration and micro-CHP)?
- ◆ What monitoring of system operations in real time and optimisation of pressures/flows will there be?
- ◆ What is the data exchange between different market players?
- ◆ Is there a need for bidirectional energy networks?

The answers to these questions are highly dependent on local considerations about needs, local energy supply, urbanism, type of gas and electricity utilisations etc. They will not be the same in all countries or even in all towns. The smart grid can be a universal concept with many possible configurations.

Conclusions

Smart gas grids are a promising way to enable a safe and efficient transition to a fully sustainable energy supply. Making the gas grid fully active and autonomous is an ambition. The most immediate issue for the smart gas network is facilitating the feed-in of biomethane, but more opportunities lie ahead.

To develop a smart gas grid, the elaboration of a dedicated roadmap is needed. Data management will certainly play a central role in the framework of the smart energy system, of which the smart gas grid will be an essential part. Therefore, it is not too soon to start thinking about and discussing the appropriate IT architecture for managing data to optimise network maintenance and control as well as to deal with suppliers or energy switching.

What are the success factors for smart grids? To achieve the ambitions explored in this article, some recommendations have already been identified:

- ◆ Promote gas appliances which accept a wider range of gas compositions. This would

allow a wider range of gas compositions in the network and introduce more flexibility in the operation of the mixtures of different gases including biogas.

- ◆ Allow for more interaction between energy carriers.
- ◆ Promote NGVs, especially in relation to public transport and commercial / goods vehicles.
- ◆ Stimulate projects on smart gas grids, including the inputs of new types of gases such as bio and synthetic methane and share the results.
- ◆ Promote biomethane injection as a route to decarbonising. This would facilitate the continued efficient use of the existing extensive gas network while achieving greenhouse gas reduction targets. Reduction of the costs of grid injection will also be an important component of this activity, to avoid project developers choosing to use biogas for low-efficiency electricity generation rather than gas grid injection.
- ◆ Develop a regulatory framework adapted to the deployment of smart grids, combined with the development of international standards that foster industrial and efficient technological solutions.

In the future, flexible grids will enable the integration of electricity, gas, heating and cooling with the aim of optimising the overall efficiency of the grids. The result will be a sustainable, economic and reliable future energy system.

Pascal Vercamer (GDF Suez, France) is the leader of Study Group 4.3 in Working Committee 4 – Distribution and Ben Lambregts (Liander, The Netherlands) is a member of SG 4.3.



▲ Data from smart meters can be used for a variety of new services.

Cameron LNG's export facility in US on track to begin construction in 2014

- Construction contract awarded to CB&I and CHIYODA
- Project to create 3,000 U.S. construction jobs

▼ Octavio Simoes, President, Sempra LNG; Phil Asherman, President & CEO, CB&I; and Mr. Nobuyuki Uchida, President, Chiyoda; at the signing of the engineering, procurement and construction contract for the Cameron Liquefaction Project.

Cameron LNG, a liquefied natural gas terminal in the U.S. south-west Louisiana region, is set to begin construction on new natural gas liquefaction and export facilities at the site of its existing regasification terminal in late 2014.

Cameron LNG awarded the engineering, procurement and construction contract for the liquefaction project to CCJV, a joint venture between CB&I and Chiyoda International Corporation, a U.S. based wholly-owned subsidiary of Chiyoda. The Cameron liquefaction project will be comprised of three liquefaction trains with a nameplate capacity of approximately 13.5 million tonnes per year of liquefied natural gas (LNG).

"The selection of CB&I and Chiyoda as contractors represents another significant milestone in the development of the Cameron LNG liquefaction-export project," said Octavio M. Simoes, president of Sempra LNG. "The engineering, procurement and construction companies we've selected have the qualifications to build large liquefaction and energy infrastructure projects as well as a firm commitment to support our project's neighbours in south-west Louisiana."

\$9 to \$10 billion investment

Earlier in the year, the project received the U.S. Department of Energy's conditional



authorisation to export to non-free trade agreement countries, including those in Europe and Asia; and received approval from the U.S. Federal Energy Regulatory Commission in June to construct the new facilities.

The project, a total investment of \$9 to \$10 billion, will create approximately 3,000 on-site jobs, as well as several hundred jobs at CB&I's fabrication facilities in Louisiana and several hundred engineering and project management jobs in the company's Baton Rouge office to support the design, fabrication and construction of the facilities.

International collaboration

Subject to a final investment decision to proceed by each party, finalisation of permits, project financing and other customary conditions, Sempra Energy will have an

indirect 50.2% ownership interest in Cameron LNG and the related liquefaction project, the remaining portion will be owned by affiliates of GDF SUEZ S.A. (GDF SUEZ), Mitsubishi Corporation [through a related company jointly established with Nippon Yusen Kabushiki Kaisha (NYK)] and Mitsui & Co., Ltd. (Mitsui), each with 16.6% stakes.

"The liquefaction project is an international collaboration with our partners from Japan and France to create a world-class facility to deliver reliable LNG supplies for more than 20 years to some of the largest LNG buyers in the world," said E. Scott Chrisman, vice-president of commercial development for Sempra LNG and project leader for the Cameron LNG liquefaction project.



An artist's impression of the Cameron LNG terminal and its future liquefaction facilities.

Cameron LNG

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Quick facts

- ▶ \$9 to \$10 billion total investment
- ▶ 3 liquefaction trains
- ▶ 13.5 Mtpa of nameplate capacity
- ▶ 3,000 new U.S. jobs at peak construction

Cameron LNG is developing one of the first new liquefied natural gas export terminals in the United States at the site of its existing regasification terminal in Southwest Louisiana.

Recently, Cameron LNG awarded the engineering, procurement and construction contract of the new liquefaction facilities to CCJV, a joint venture between CB&I and Chiyoda International Corporation.

Construction of the new facilities is planned to begin by the end of 2014. The project will supply natural gas to global markets.

To learn more about the Cameron LNG liquefaction project and employment opportunities, visit **www.CameronLNG.com**.



*Sempra Energy has an indirect 50.2-percent ownership interest in Cameron LNG and the related liquefaction project, the remaining portion is owned by affiliates of GDF SUEZ S.A. (GDF SUEZ), Mitsubishi Corporation (through a related company jointly established with Nippon Yusen Kabushiki Kaisha (NYK)) and Mitsui & Co., Ltd. (Mitsui), each with 16.6-percent stakes.

Q&A with Bjørn Håmsø, Manager of the GGFR Partnership

The World Bank-led Global Gas Flaring Reduction (GGFR) Partnership entered its second decade with a new Manager. The IGU Magazine asked him about the challenges going forward.

Mr Håmsø, you took over as GGFR Manager in August 2013; how has your first year in the post been?

Exciting. I had a long career in Statoil before joining the World Bank in 1999. Transitioning from managing a Bank project portfolio to working on gas flaring, together with partners in the oil industry and governments, is going back to an environment in which I feel very comfortable. Working on gas flaring reduction is tremendously rewarding because no one, including oil companies, wants flaring to happen and we're all working together to identify solutions. Our initiative has a number of attractive aspects, including the public-private partnership component; the fact that our efforts have a positive impact on the environment; that sometimes the solutions can lead to energy access where it is lacking; the utilisation of a valuable natural resource. Also, the results are clearly visible and beneficial to the average person, no matter where you live in the world.

Gas flaring reduction requires a wide array of solutions because each situation is unique in terms of location, available infrastructure, the political and regulatory environment, and many other variables. So our Partnership strives to approach the challenge in a creative manner, looking for the most economical, technically viable solutions. In some cases flaring can be eliminated by narrow, self-contained solutions

like converting the gas to liquids, while in other cases large-scale infrastructure networks and further development of local energy markets are required.

There are currently some 30 government and industry GGFR partners; how do you see membership developing?

I expect a growth in membership as more and more companies and governments recognise the situation is unsustainable from a resource

Bjørn Håmsø

Bjørn Håmsø is Manager of the GGFR Partnership, an initiative led by the World Bank in Washington, DC. Prior to taking on this position in August 2013, he managed large World Bank gas



and power investment projects in India, Pakistan and several countries in Europe and Central Asia. Before joining the World Bank in 1999, Mr Håmsø had a long career in Statoil, where he was engaged in marketing of Norwegian gas to European buyers and also was Director for Statoil's electricity marketing in Scandinavia. In the mid-1990s, Mr Håmsø was a Senior Vice President for The Eastern Group, Virginia, USA, where he was responsible for total energy solutions business development.



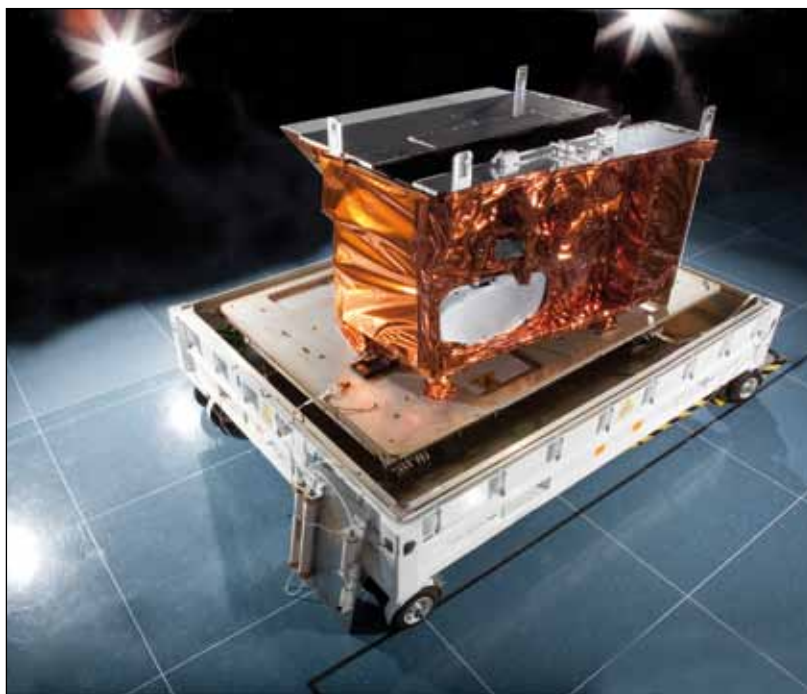
management and environmental perspective. GGFR is a good example of how collaborative partnerships between the public and private sectors can yield results. As our partners are able to continue to demonstrate results, others will see the benefits of joining. Some of this of course also depends on the ability and willingness to help finance the organisation.

Would you like to highlight any recent projects that GGFR partners have implemented?

In general terms, over the last few years we have seen substantial progress in flaring reduction by several companies and countries in our partnership. Significant progress has been made in Azerbaijan, Kuwait, Qatar, Mexico, Russia and the Republic of Congo. Also, GGFR's international oil company partners are successfully working to reduce their gas flaring in many locations around the world, such as Nigeria and Angola.

But while this progress is encouraging and motivating, we must do more. So let me use this opportunity to comment upon the World Bank's upcoming initiative to eliminate routine flaring by 2030. The Bank is a founding member of GGFR and has reason to believe that if a large number of governments and national and international oil companies support an initiative to set a target date, it will have a real impact on how countries and companies approach development of new oil fields and how they tackle the problem of "legacy" flaring. Global gas flaring is currently around 140 bcm annually and needs to be reduced to a minimum for the reasons mentioned earlier. Let me illustrate the proportions of the problem. If the gas that is currently flared were used to fuel power plants, for instance, it could generate about 750 billion kWh of electricity, or more than the current electricity consumption of the entire African continent.

▲ Gas flaring reduction requires a wide array of solutions.



▲ Visible Infrared Imaging Radiometer Suite (VIIRS) detectors are the latest tool being used to gather satellite-estimated flaring data.

GGFR has been working with the US National Oceanic and Atmospheric Administration (NOAA), to calibrate and utilise new satellite data to estimate gas flaring volumes. Although the latest data is still being processed, can you tell us about the new technology?

We are currently in a transition to this technology. Satellites carrying the Visible Infrared Imaging Radiometer Suite (VIIRS) detectors were launched in late 2011. VIIRS, with multiple detectors covering the optimal flare detection wavelength and significantly better aerial resolution than previously available detectors, has the potential to quantify the volume of gas for individual flares in every country in the world. This should significantly enhance the quality of satellite-estimated flaring data. More work is still required to calibrate the raw VIIRS data in terms of flared gas volumes, and we need reliable, on-site data from flaring sources that cover as wide a range in flared volumes and geographical locations as possible. It is proving to be painstaking work, and GGFR is providing its full support to NOAA in the effort.

The GGFR Partnership has made substantial strides and gas flaring fell nearly 20% between 2005 and 2011. The World Bank's upcoming initiative to eliminate routine flaring by 2030 constitutes an agenda that requires action right away. How do you plan to scale up your efforts to achieve that?

Hopefully, the World Bank initiative will prompt many governments and oil companies - especially the large national companies - to follow the lead of major international oil companies and not accept routine flaring in new oil field developments. That would be a good start.

Furthermore, there is significant potential to further leverage flare reduction through the World Bank Group, in which GGFR is embedded. Two developments should help in that respect. First, the Bank's reorganisation this year into global practices, which brings the community of energy practitioners in the Bank closer together for greater, more intensive collaboration and information (and ideas) exchange, will be of great benefit. Secondly, the World Bank and many others have clearly identified natural gas as a transitional fuel to a less carbon-intensive future. This makes it easier to obtain support for gas flaring reduction initiatives that harness and utilise the gas for development and energy access purposes. A good example of this is the partial risk guarantee that the Bank has recently provided in Nigeria, which guarantees the performance and fulfilment of duties (such as payment for electricity) of state entities in the power supply chain. This may move power plants in Nigeria from the drawing table to implementation - plants fuelled in large part by gas that is currently flared.

Let me make clear that the GGFR Partnership has relatively little direct involvement in specific gas flaring reduction projects. We focus predominantly on facilitation, regulation, knowledge sharing and other aspects, rather than project implementation. It is often



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▲ While light from flaring and urban areas can be difficult to distinguish, offshore flaring as seen here in the Bahía de Campeche in the Gulf of Mexico is easy to spot.

government energy policies, and their ability to execute them, that determine how quickly a country's gas flaring is reduced.

The World Bank is closely involved in the UN Sustainable Energy for All (SE4ALL) initiative (World Bank Group President Jim Yong Kim co-chairs the Advisory Board). How would that impact GGFR?

Eliminating routine gas flaring by 2030 is a World Bank initiative, but we expect the Bank will request the GGFR Partnership use its resources to advance the initiative. Support for the initiative will benefit greatly from the support of SE4ALL, which can provide access to high-level decision makers in governments around the world. Furthermore, SE4ALL was established, in part, to help mitigate climate

change, so embracing gas flaring reduction is clearly in line with the SE4ALL mission.

How does the climate change agenda influence the gas flaring reduction agenda?

It brings more visibility to our work. An increasing number of people say that the estimated 350 million tonnes of annual CO₂ emissions from gas flaring is unacceptable because it is a problem that can be solved. In the broad context, it is relatively low-hanging fruit. However, we also see heightened awareness and focus on gas flaring because it emits black carbon, a so-called short-lived climate pollutant. Early-stage research indicates that black carbon emissions from flares in and near the Arctic may cause 40% or more of the black

carbon that deposits on the Arctic snow and ice cap¹. These deposits have a severe negative impact on the reflective power (albedo) of the ice cap and it accelerates melting.

Finally, let me mention that communication is an essential part of the solution to end routine gas flaring. Awareness of its magnitude, its impact, and the potential to reduce it is crucial. We have an important job ahead of us, and many of IGU's members will play essential roles getting the job done.

For more information on the GGFR Partnership, visit www.worldbank.org/ggfr.

1 A. Stohl et al. (2013): "Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emissions", *Atmospheric Chemistry and Physics*, 13, pp8833-8855.



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IGU Report Highlights Expansion of Small-Scale LNG

Many new regions are turning to small-scale liquefaction and retail LNG in order to cut emissions or fuel costs. IGU's World LNG Report – 2014 Edition has a special section on this dynamic, fast-moving sector of the industry and here we give an overview.

IGU defines small-scale liquefaction and regasification facilities as plants with a capacity of under 1 mtpa. In turn, small-scale LNG ships are defined as vessels with a capacity of under 18,000m³.

The small-scale production and consumption of LNG can be separated into two basic categories: wholesale and retail. Small-scale wholesale LNG is essentially a miniaturisation of the conventional LNG value chain; gas is liquefied in small quantities, transported on a small vessel, and then imported at a small regasification plant. Retail LNG is the small-scale

consumption of LNG in end-user applications, such as transport, power generation, or industrial activities.

Compared to the well-established large-scale LNG business, small-scale LNG (SSLNG) is characterised by different dynamics and drivers. Therefore, the production, transportation and regasification of SSLNG for new market segments such as the transportation and small industrial sectors requires the application of a variety of different technologies and commercial models to meet efficiency and cost requirements.

Wholesale SSLNG mirrors the large-scale business in that it typically involves the inter-continental transport of LNG from a liquefaction plant in a producing country to a regasification plant closer to the end-user (e.g. power plants, industrial users).

► The 0.3 mtpa Skangass LNG plant in Stavanger, Norway.



The retail LNG business is characterised more by an “end-user oriented” value chain. Such a value chain represents a more regional or local business that distributes and delivers smaller amounts of LNG from the liquefaction source directly to end-users, using various modes of transport (e.g. ships, trucks, semitrailers, ISO containers, or trains). This new value network can link into an existing large-scale value chain at any point, including the liquefaction plant, LNG carrier, or regasification plant. It can supply LNG for new applications, such as marine and road transport fuel, but can also allow access to LNG for previously stranded customers, such as scattered islands or coastal areas.

The production and transportation of LNG at such a smaller scale requires the application of different technologies. For example, less efficient liquefaction processes may become a more optimal choice at a smaller scale, such as Single Mixed Refrigerant and Nitrogen Expansion cycles. Different types of equipment may also be selected: reciprocating and screw type compressors may be preferred to the centrifugal compressors usually employed in large-scale liquefaction plants, while plate-fin cryogenic heat exchangers might be preferred over coil-wound heat exchangers.

The development of a small-scale value network also poses new logistical challenges, such as the management of boil-off gas (BOG) produced during the transport of LNG (in contrast to the large-scale business, BOG management often corresponds to containment under pressure in vessels), limited availability of small LNG carriers on the market, and ensuring the compatibility and safety standards of all elements of the value chain.

Small-scale liquefaction

Small-scale liquefaction plants are built with a variety of objectives in mind, including commercialising small gas fields, shortening gas-to-market times, marketing small quantities of gas usually flared, peak shaving and direct use of LNG.



While many companies are developing stand-alone small-scale units, others have proposed building large-scale projects with multiple small modular liquefaction units. This is the concept behind many large floating proposals, which contain multiple 0.25-1.0 mtpa units on a barge or vessel, but the concept is also proposed to be used in onshore projects.

The developers of most small-scale projects turn to small-scale liquefaction either because their targeted gas reserves are not large enough to support a bigger project, or because they hope to take advantage of cost and time efficiencies from less infrastructure and a more modular design. Smaller plants are estimated to have a shorter construction time and a much shorter design and engineering schedule. This is particularly true if they target pipeline gas as feedstock rather than a small gas field, allowing for more rapid responses to demand surges. The 0.3 mtpa Skangass LNG plant in Norway was completed in around three years, compared to four-to-five years for a large-scale facility.

Further, capex requirements are obviously significantly lower, but on a \$/tonne basis they are not necessarily more competitive than their large-scale counterparts. Small-scale plants lack any benefits that economies of scale give to larger projects, but due to their minimal size and relative simplicity, there is a lower need for

▲ Sweden started small-scale imports of LNG in 2011. The *Coral Methane*, an SSLNG carrier with a capacity of 7,500m³, at the Nynäshamn regasification terminal.

on-site infrastructure (such as independent power generation) and specialised equipment.

In addition to global exports, small-scale liquefaction plants are also being constructed for a variety of domestic uses. Traditionally, LNG has been consumed as a replacement fuel for diesel or other oil products for power generation or industrial uses, either due to a plant's remote location or as a way to cut costs.

SSLNG units are also often used as peak shavers to help meet demand. These facilities contain both liquefaction and regasification abilities to more compactly store gas until times of peak demand, when the LNG can be quickly regasified for use in retail applications, such as power generation or residential consumption.

The construction of liquefaction units for the purpose of providing LNG as a fuel for transportation is a more recent phenomenon that is fast gaining ground in China and the US, though it has also proliferated around the globe. Both countries have a sizeable LNG-fuelled trucking sector. China, in particular, has rapidly built up its domestic liquefaction infrastructure to replace diesel and cut vehicle emissions.

Small-scale regasification

The majority of small independent regasification units (not including those in peak shavers) are used to import globally-produced LNG, and are located in areas with limited demand or size constraints.

Currently, Japan holds the most existing small-scale import terminals, many of which were built as satellite plants or units near larger, older terminals, though some can attribute their small size to space constraints or lower demand. Small-scale import functions similarly to floating regasification; their advantages are primarily lower cost, speed of construction and added flexibility. Indonesia has proposed building nearly a dozen "mini" LNG terminals in order to service islands with no gas pipeline infrastructure; the plants would all be supplied by domestic LNG produced at Bontang LNG.

Multiple European countries have proposed building small-scale import terminals, spurred by EU subsidies for developing LNG that could be as large as 10-20% of the terminal development cost.

There are several different LNG sourcing strategies among small-scale terminals. Some, like the Fredrikstad terminal in Norway, are supplied by regional small-scale liquefaction (in this case, Skangass LNG in Norway). In Japan and China, some small-scale terminals are supplied by traditional large-scale liquefaction plants, such as Malaysia LNG and Bontang, using SSLNG carriers. A third set of terminals receive LNG that has been produced by large-scale international terminals (hubs), but is first delivered to larger import plants and then transferred by small shuttle vessels or onshore trucks. Several of the Japanese terminals operate in this way, while Chile has a small onshore regasification facility located near a refinery in Pemuco, to which it transports LNG from the large-scale Quintero regasification plant on the coast.

Offshore small-scale LNG transportation

A portion of small-scale coastal terminals are able to receive traditional LNG carriers, though the vast majority utilise LNG shuttle vessels. These small vessels, which range in size from 1,000m³ to 18,000m³, primarily carry cargoes between large- and small-scale terminals, though they can occasionally make the trip between large-scale liquefaction plants and small-scale terminals.

In addition to shuttle vessels, which are essentially miniaturised versions of conventional LNG carriers, some small-scale trade is also proposed to be carried out by conventional cargo ships carrying 45,000 litre (20t) ISO containers full of LNG. This concept, which is fairly nascent, provides the basis for all of the small-scale export applications currently before the US DOE (such as Carib Energy's 0.2 mtpa proposal to deliver volumes to the Caribbean).



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▲ Fjord Line's *Stavangerfjord* is one of a growing number of passenger vessels fuelled by LNG.

Retail LNG

LNG is consumed in a number of retail applications, including transport, power and industry. The use of LNG in road transportation as a replacement fuel for diesel has proliferated most rapidly in areas with more stringent environmental standards for vehicle emissions, such as the US West Coast, Europe and China. The latter has seen the strongest growth, with over 400 stations in place at the end of 2012; there are plans to more than quadruple this by 2015.

Further, in 2013, LNG-powered trucks accounted for 7% of all heavy duty vehicle sales in China. Outside of China, the US has the next

▼ UPS is expanding its LNG-fuelled trucking fleet.



largest presence in the onshore LNG transportation industry. Refuelling stations are concentrated mainly in the state of California due to its more aggressive emissions standards. As of January 2014, over 50% of stations were located there, with most of the remainder scattered in isolated markets throughout the rest of the country.

Multiple European markets have some LNG fuelling infrastructure, including Portugal, Spain, Italy, Sweden, Estonia, Finland and the Netherlands. As in the US, these stations are isolated and do not form transportation corridors, though the LNG Blue Corridors Projects are underway to invest in infrastructure along the four major European trucking routes. The current European Commission's four-year project aims to demonstrate and roll-out the feasibility of four LNG corridors throughout Europe. This will include building new LNG or L-CNG stations and building up a fleet of LNG heavy duty vehicles which will operate along the corridors.

LNG can also be consumed as fuel for marine transport. In order to cut down on sulphur emissions, the EU has been promoting the consumption of LNG as marine fuel. Although currently there are few vessels that are capable of using LNG as bunker fuel (apart from LNG carriers), the number of proposals has been growing. Given the level of government support in Europe, schemes located in countries such as Norway and the Netherlands are furthest along, while several more have been proposed in the Gulf Coast and Great Lakes regions of the US.

As with the growing use of LNG in transportation, the use of LNG in the power and industrial sectors is spurred by a desire to cut emissions. Several oil and gas companies in the US and Canada have proposed plans to install LNG capabilities at production sites to fuel drilling rigs and hydraulic fracturing units. These plans have also been influenced by the cost differential between LNG and alternate liquid

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► LNG being loaded into an ISO container at Clean Energy's liquefaction plant in Boron, California, for transport to Hawai'i Gas in Honolulu.



fuels. In areas like the US or Europe where gas or LNG prices are consistently lower than oil and diesel prices, the price disparity between oil and gas is a major argument for onshore LNG consumption. Countries that rely heavily on higher-priced diesel for power and industrial uses have also begun to look to LNG as a replacement fuel in these sectors. This is particularly relevant for remote areas and islands where pipeline infrastructure is too costly.

Outlook

SSLNG is growing across the globe and is expected to go a long distance. The industry is very dynamic in North America, driven by increased gas availability from shale gas production, as well as economic factors such as the substantial price differentials between gas and oil products. The economic and environmental advantages of using LNG as fuel will drive growth in China, to fight pollution in urban areas, while stricter regulations on the marine sector will boost the use of LNG in Europe.

The growth of the SSLNG business is tightly linked to the development of LNG demand. However, this creates a potential stalemate where consumers wish for security of supply before committing to LNG, while potential suppliers need to secure a market to justify the investment. The unlocking of such a dilemma is being addressed in different ways in different

parts of the world. Regional factors such as the lack of pipeline infrastructure and increasing emission regulations strongly support the growth of SSLNG.

The main challenges for SSLNG lie in the development of a consistent normative and regulatory framework, including safety standards for the handling of SSLNG and investments to provide the infrastructure to support a wider distribution without jeopardising cost effectiveness. However, implementation of this value chain will introduce new challenges, for example in the area of BOG management and meeting fuel quality requirements to use LNG as fuel. Still, no technical bottlenecks hinder the growth of this sector. Moreover, improvements to project economics are expected from standardisation and modularisation for production facilities.

For more information on SSLNG including a detailed regional round-up see IGU's World LNG Report – 2014 Edition which can be downloaded from www.igu.org. This important reference document for the industry was prepared by a team from Programme Committee D chaired by Dirk van Slooten of VSC Hattem and retired from Vopak. Study Group D.5 (led by Philippe Corbière of Total) had overall responsibility for the report with the SSLNG section the work of Study Group D.3 (led by Wouter Meiring of Shell).



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ALL THE REASONS. ALL THE CONFIDENCE.

Floating Regas Gains Momentum

By Mark Blacklock

As highlighted at last year's LNG 17 conference, the development of floating LNG is opening up new opportunities. We covered floating liquefaction in the October 2013-March 2014 issue, now Mark Blacklock gives an overview of the regasification scene and in the following article Rod Morrison looks at recent financings in the sector.

The floating option for regasification of LNG is gaining momentum as countries around the world appreciate its flexibility, cost-effectiveness and the relative speed of gaining access to new gas supplies in this way. A typical floating regas terminal with an annual capacity of 5 bcm represents an investment of around half that for a conventional, onshore facility.

In 2013, China, Israel and Italy commissioned their first floating regas terminals. So far in 2014, new terminals in Brazil and Indonesia have started operations with one in Lithuania due to be commissioned by the end of the year. Bangladesh, Jordan, Puerto Rico and Uruguay have projects set to come online in 2015.

▼ Floating regas enabled Argentina to establish the continent's first LNG import facility in just 10 months – Excelsior receives a cargo from Excelsior in Bahía Blanca.



Floating regasification was pioneered by Excelsior Energy which developed its Energy Bridge concept when US LNG imports were expected to surge. This is based on a floating storage and regasification unit (FSRU) which receives cargoes via ship-to-ship transfer from an LNG carrier and discharges to the gas grid either alongside a jetty or offshore via a submerged turret loading (STL) buoy.

Excelsior teamed up with the Exmar shipping group to operate a fleet of purpose-built FSRUs, which can also serve as LNG carriers, and commissioned the Gulf Gateway Deepwater Port offshore Louisiana in March 2005. Excelsior's Northeast Gateway offshore Massachusetts followed in May 2008. The shale boom was to change the US gas trading picture radically, but the flexibility of the concept proved its worth in new markets. Indeed, when Excelsior decommissioned the Gulf Gateway in 2012 some of the equipment was recycled and used in the company's other projects.

South America and the Caribbean

Floating regas really took off in South America and enabled Argentina to establish the continent's first LNG import facility in just 10 months. To meet a shortage of gas in the peak winter months, Repsol-Stream and YPF teamed up with Excelsior in 2007 to develop the Bahía Blanca Gas Port which began operations in June 2008. Initially a seasonal operation with the FSRU being deployed elsewhere during the summer, it has now become a year-round one. Bahía Blanca was followed in June 2011 by GNL Escobar, 48km outside Buenos Aires, which was developed by YPF and Enarsa with Excelsior. In 2013, the

two terminals imported 6.9 bcm which met 14% of Argentina's gas consumption.

Brazil also opted for the floating option to start LNG imports and Petrobras worked with Golar LNG on the first phase. Two LNG carriers were converted into FSRUs and based at Pecém, in the state of Ceará (*Golar Spirit*) and Guanabara Bay in the state of Rio de Janeiro (*Golar Winter*). Operations started in 2009.

Petrobras subsequently teamed up with Excelerate to increase import capacity. A short-term charter of *Exquisite* for the Guanabara Bay terminal started in December 2012. In 2013, the two terminals then in operation imported 5.1 bcm (13% of Brazil's gas consumption). Meanwhile, a third terminal was being developed by moving the *Golar Winter* to Baía de Todos os Santos, Salvador, where operations started in January.

In May, *Exquisite* was replaced by the new-build *Experience*. With a storage capacity of 173,400m³, this is the largest FSRU in service but it will be surpassed in late 2016 by a new 263,000m³ FSRU ordered for GNL del Plata.

Uruguay will become the third South American country to introduce floating regas in 2015 when GNL del Plata 4km offshore Montevideo is inaugurated. Gas Sayago is working with GDF Suez and Marubeni on the project which will have an offshore jetty protected by a breakwater. Operations will start using the *GDF Suez Neptune* originally built for a now-suspended US operation, the Neptune Deepwater Port offshore Massachusetts. The vessel is operated by Høegh LNG. In late 2016, it will be replaced by a larger FSRU which has been ordered from DSME in Korea and will be chartered from Mitsui OSK Lines.

Meanwhile in the Caribbean, Puerto Rico is working with Excelerate to expand LNG import capacity. The US Commonwealth has had a conventional, small-scale regasification terminal since 2000, and aims to supplement this with a larger floating facility. Subject to FERC authorisation, the Aguirre Gas Port will be moored



6.4km offshore and is due to start up in late 2015 to supply the Puerto Rico Electric Power Authority's Aguirre plant.

▲ *Experience* is stationed in Guanabara Bay under contract to Petrobras. With a storage capacity of 173,400m³, it is the largest FSRU in service.

Middle East and Africa

Kuwait introduced floating regas to the Middle East to meet peak summer energy demands and Kuwait National Petroleum Corporation worked with Excelerate to commission the Mina Al-Ahmadi Gas Port in August 2009. In 2013, the facility imported 2.1 bcm. A new contract with Golar LNG started in March and the purpose-built FSRU *Golar Igloo* is spending nine months a year there.

Dubai in the UAE started LNG imports in 2010 and the Dubai Supply Authority has a contract with Golar LNG to base the converted *Golar Freeze* in the Port of Jebel Ali. In 2013, imports amounted to 1.5 bcm.

Israel opted for LNG as a temporary solution to a shortage of gas for power generation



▲ *Golar Freeze* in Jebel Ali, Dubai receiving a cargo from Qatar.

caused by attacks on the pipeline from Egypt and declining domestic production. Floating regas was the quickest way to tide the country over until volume production from new offshore fields starts. Israel Natural Gas Lines worked with Exceleerate to develop a terminal 10km offshore Hadera using the SLT buoy system, which started operations in January 2013 and imported 0.56 bcm last year.

Jordan too has suffered disruption in its pipeline supplies from Egypt and is developing an LNG import terminal 18km south of Aqaba for start-up in 2015. This will use the purpose-built FSRU *Golar Eskimo* which is under construction at the Samsung Heavy Industries yard in Korea. Jordan's Ministry of Energy has contracted the vessel and Aqaba Development Corporation is responsible for the jetty.

Meanwhile, Egypt is facing surging domestic gas demand while production has been declining. Feedstock for the country's LNG exports has been reduced and there is a need for imports. Egyptian Natural Gas Holding Company (EGAS) is negotiating with Høegh LNG to base the purpose-built FSRU *Høegh Gallant* in the Port of Ain Sokhna, on the Gulf of Suez.

At press time, Quantum Power Ghana Gas was nearing a final investment decision on a

project to lease an FSRU from Golar LNG. The plan is to base the vessel offshore Tema to supply gas to the country's main power generator, the Volta River Authority, from 2016.

Asia-Pacific

Indonesia also faces increasing domestic gas demand and is using some of its LNG production, which was originally dedicated to export markets, to help meet local needs. Two FSRUs are currently in service and more are under evaluation.

Nusantara Regas, a joint venture of Pertamina (60%) and Perusahaan Gas Negara – PGN (40%) contracted with Golar LNG to convert an LNG carrier and the *Nusantara Regas Satu*, in Jakarta Bay, West Java was commissioned in 2012.

PGN went it alone for a second project and contracted a purpose-built FSRU from Høegh LNG, which was also responsible for the tower yoke mooring system (TYMS), the first time this has been used for an LNG import terminal. Moored 6km offshore Lampung, Sumatra, the *PGN FSRU Lampung* received its first cargo in July.

In October 2013, CNOOC commissioned China's seventh LNG import terminal and its first floating facility. It has contracted the *GDF Suez Cape Ann*, which is operated by Høegh LNG and based in the Port of Tianjin.



A Strong Commitment to Deliver a Good Energy Solution

We are committed to ensuring that Indonesia could continue to benefit from natural gas that is not only efficient, but also environmentally friendly. Therefore, PGN continues to strengthen its downstream and upstream businesses, encouraging the amplification of the natural gas industry chain as sustainable Good Energy Solution.



▲ PGN FSRU Lampung is Indonesia's latest floating regas terminal and the first to use a tower yoke mooring system.

The latest country in the region to opt for floating LNG is Bangladesh, where Petrobangla has signed a 15-year deal with Exceleerate to use the SLT buoy system offshore Moheshkhali Island in the Bay of Bengal. Start-up is projected in late 2015.

Europe

When the UK restarted LNG imports four new terminals were developed between 2005 and 2009, one of which was an Exceleerate project.

Teesside Gas Port was commissioned in February 2007 but does not have a dedicated FSRU and only receives ad hoc deliveries.

In Italy, OLT Offshore LNG Toscana commissioned the converted FSRU *Toscana* in December 2013. Moored 22km offshore Livorno, it is operated by ECOS, a joint venture created in 2010 by Fratelli Cosulich SpA, which owns 40% of the company, and Exmar, which owns 60%. And Lithuania's Klaipėdos Nafta is set to start LNG imports in the final quarter of the year using the new-build *Independence* chartered from Høegh LNG. It will be moored in Klaipėda harbour.

Looking ahead

With a large number of proposals on the table around the world, floating regas is set to play an increasing role in the LNG business. However, the onshore option remains attractive for larger capacity terminals.

Mark Blacklock is the Editor-in-Chief of International Systems and Communications.

► OLT Offshore LNG Toscana commissioned the FSRU *Toscana* in December 2013.



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- Gas to Liquids (GTL)
- Natural Gas Liquid (NGL) recovery

Floating on Finance – FSRUs

By Rod Morrison

The development of the FSRU market has enhanced the growing flexibility in the LNG business and debt finance for this new type of vessel is readily accessible. Banks have been used to providing loans to the floating production storage and offloading (FSPO) sector in the oil industry for years. Adapting these financing techniques has not been too challenging in the FSRU sector, albeit there are differences, mainly with the technology risk. Both rely on charter payments from the clients, the gas buyers, for providing the vessels.

Key in the financing is the creditworthiness of the gas buyer, the counterparty in the deal. FSRUs have become an attractive option in emerging markets to service smaller-scale gas demand. This could be a cause for concern in

relation to the counterparty credit risk as there are fewer creditworthy entities in these countries. But in many of these deals, the buyers are often the best-rated corporates in the country.

Specialist FSRU players have emerged. But traditional large-scale project sponsors are starting to use the concept too.

Financings

Höegh LNG is a specialist player. It has arranged three financings, all different in nature to meet individual circumstances.

Earlier this year it received commitment letters on a \$400 million corporate, on balance sheet loan to pay for two FSRUs. The loan runs for five years post-delivery but has a 15-year repayment profile so will require refinancing at

► Höegh obtained a \$250 million corporate financing for the Klaipėdos Nafta FSRU. Named *Independence* in a ceremony at the Hyundai yard in Ulsan, Korea in February, the vessel is due to start operations in Lithuania by the end of the year.



the end of five years. Each unit has a capacity of 170,000m³ and one was delivered by Hyundai Heavy Industries in June with the second due in March 2015. The loan is being provided by ABN Amro, Citigroup, Crédit Agricole, Danske, BND, Nordea and Swedbank.

Last year the company secured a \$310 million project financing of the Lampung project in

Indonesia. The financing is secured only on the vessel and not on Höegh's corporate balance sheet. The loan is divided into four tranches, split into facilities for the FSRU and for the mooring project. For the FSRU, there is a \$178.6 million 13-year K-Sure covered tranche that matures in October 2026 and a \$58.5 million eight-year uncovered tranche that matures in October 2021. K-Sure is the export credit agency (ECA) of South Korea which provides guarantees on loans where the equipment supplier is South Korean. The covered facility pays 230bp over libor while the uncovered portion pays 340bp. The banks are BTMU, DBS, KDB, OCBC and Standard Chartered. The counterparty is PGN of Indonesia and the contract runs for 20 years.

In 2012, Höegh obtained a \$250 million corporate financing for the Klaipėdos Nafta unit in Lithuania. The banks are DNB, Nordea, SEB and Swedbank. The seven-year loan, with an overall profile of 16 years, is 75% guaranteed by K-Sure and Norwegian ECA, GIEK. The margin is 310bp. Höegh has a 10-year charter with Klaipėdos Nafta.

Another specialist is Golar LNG. In 2013, it financed the first eight of its 13-ship programme via a \$1.125 billion corporate style ECA-backed loan led by Citigroup. The loan runs for 12 years and its cost, in the seven years



when it is hedged, is 3.74%. The deal is split into three tranches – a \$450 million term loan 95% guaranteed by K-Sure, a \$450 million Kexim South Korean government direct loan and a \$225 million commercial bank loan. Other banks in the deal include Danske, DvB, Nordea, KFC, SEB and Swedbank.

Golar agreed a deal for an FSRU in the Bay of Mejillones with Chile's Gas Atamaca in 2012, but this was subsequently put on hold. If the project gets the final go-ahead, Golar will look to finance an initial contract term of 15 or 20 years, at Gas Atamaca's option.

In Uruguay a more traditional project sponsor, GDF SUEZ, is working with Gas Sayago on the GNL del Plata import terminal. For 15 years, GDF SUEZ will receive a \$5 million monthly rental fee for use of an FSRU and a \$2 million/month fee for regasification, operation and maintenance of the terminal. The financing is yet to be finalised but is likely to involve Japan's ECA, JBIC and the Inter-American Development Bank.

The FSRU is a new tool in the LNG marketplace and its role can only grow in importance, as occurred in the FSPO sector in the oil industry.

Rod Morrison is a London-based journalist specialising in project finance.

▲ Golar Eskimo will be the next of Golar's new-builds to be delivered by the Samsung yard in Geoje, Korea for service in Jordan.

PETRONAS Floating LNG Facilities

Bringing LNG to Asian Markets

Increasing demand for cleaner burning fuel and a growing global demand for energy has spurred the development of new technologies to access and monetise hard to reach and previously uneconomical gas reserves.

PETRONAS is at the forefront of the gas revolution with its expansion into the niche area of floating Liquefied Natural Gas (LNG) facilities. One of the first in the world, these facilities will enable the company to monetise stranded gas from small and scattered conventional fields in its domestic acreages offshore Sabah and Sarawak.

PETRONAS Floating LNG 1 (PFLNG 1) has a capacity of 1.2 million tonnes per annum (mtpa) and is targeted for commissioning in the Kanowit Field offshore Sarawak in 2015. PETRONAS FLNG 2 (PFLNG 2), with a larger capacity of 1.5 mtpa, is scheduled for commissioning in 2018 in the Rotan Field offshore Sabah. The construction of these facilities strengthens PETRONAS' position as a major LNG player and supports Malaysia's efforts to be the regional hub for oil and gas services in Asia.

The benefits of this approach are already apparent, unlocking new reserves that used to be deemed too challenging or too expensive. With its capacity to extract natural gas from offshore wells, liquefy and store it for later transport, PFLNG will open up reserves of natural gas to be processed into LNG which will be sold in Peninsular Malaysia and other key regional markets at prevailing market prices.

With Asia accounting for approximately 61% of increased demand for primary energy in the world up to 2035, PFLNG1 ensures security of supply to growing Asian markets. With natural gas gaining importance as a source of fuel for power generation in the region, this flagship project forms a key part of PETRONAS' long-term growth strategy.

Major Operational and HSE Milestone

A recent major milestone in the development of the PETRONAS Floating LNG project was the launch of its 365-metre hull, which took place in April 2014 in Okpo, South Korea. The construction of this massive hull, which has a length equivalent to three NFL football fields, achieved more than 5.5 million total



PETRONAS FLNG 1 under construction at the Daewoo Shipbuilding & Marine Engineering (DSME) shipyard in Okpo, South Korea.



The recently launched hull of the PETRONAS FLNG 1 facility. It is slated to be the world's first floating LNG facility in operation.

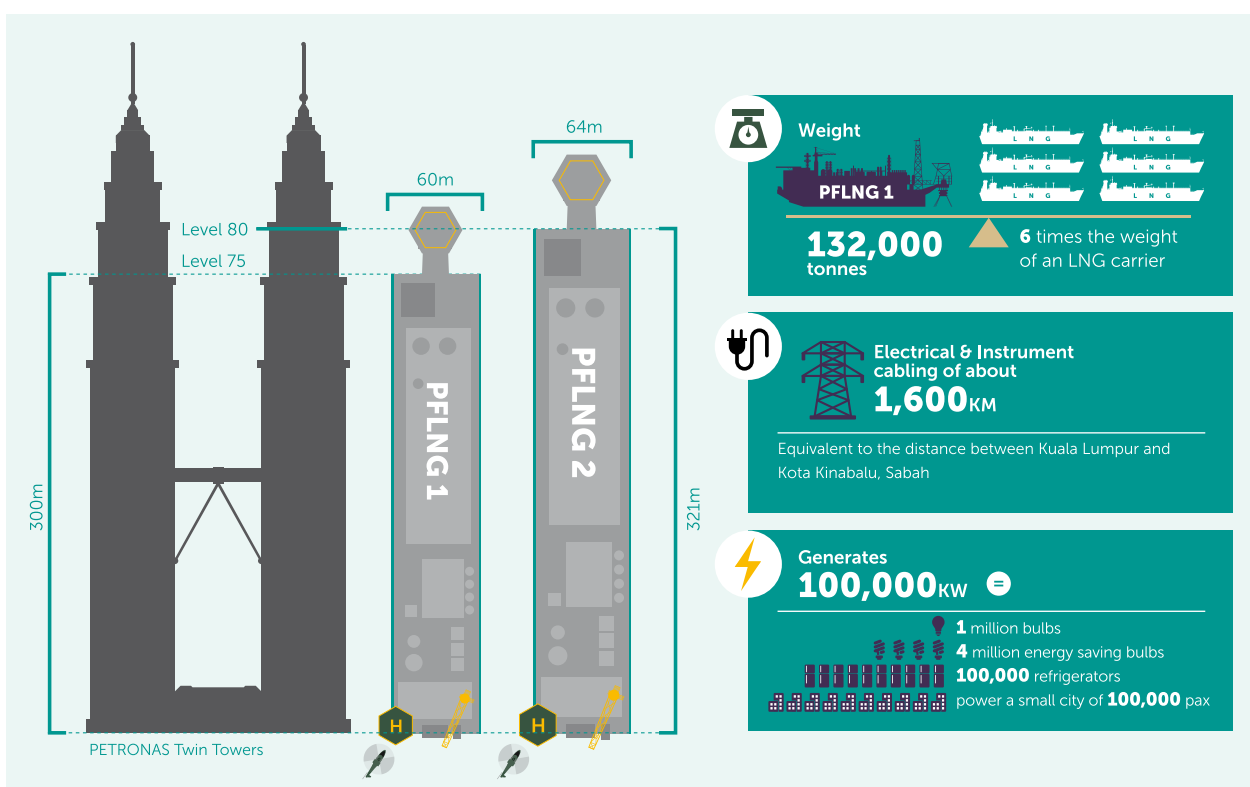
safe man-hours with no loss time incidents at the project site since it commenced in March 2012. The construction of the topsides, weighing a mammoth 132,000 tonnes, is currently ongoing.

Designed to access stranded gas assets and eliminate the high costs associated with the construction of infrastructure such as subsea pipelines involved in transporting gas to shore, the knowledge and technical expertise gained from the PFLNG project enhances PETRONAS' core capabilities and enables more efficient monetisation of gas reserves. The project draws on over 35 years of experience in integrated oil and gas operations and will support

PETRONAS' position as one of the major LNG players in the world.

PETRONAS continues to seek new opportunities to access hydrocarbon resources efficiently and effectively. The company is constructing another train at the PETRONAS LNG Complex in Bintulu, which will increase its capacity by 3.6 mtpa. Malaysia's first regasification facility (RGT 1) is also up and running. With a growing portfolio in unconventional gas assets in Canada and Australia, PETRONAS is positioning itself to pursue value driven and sustainable growth in natural gas.

Physical Dimensions of PFLNG 1 and PFLNG 2



IGU Pricing Survey Confirms Growth of Gas-on-Gas Competition

By Mike Fulwood

IGU's Wholesale Gas Price Survey aims to promote international understanding of natural gas pricing and wholesale gas price formation trends. This is an overview of the latest edition which was published in May.

▼ The latest edition of IGU's Wholesale Gas Price Survey is now out.

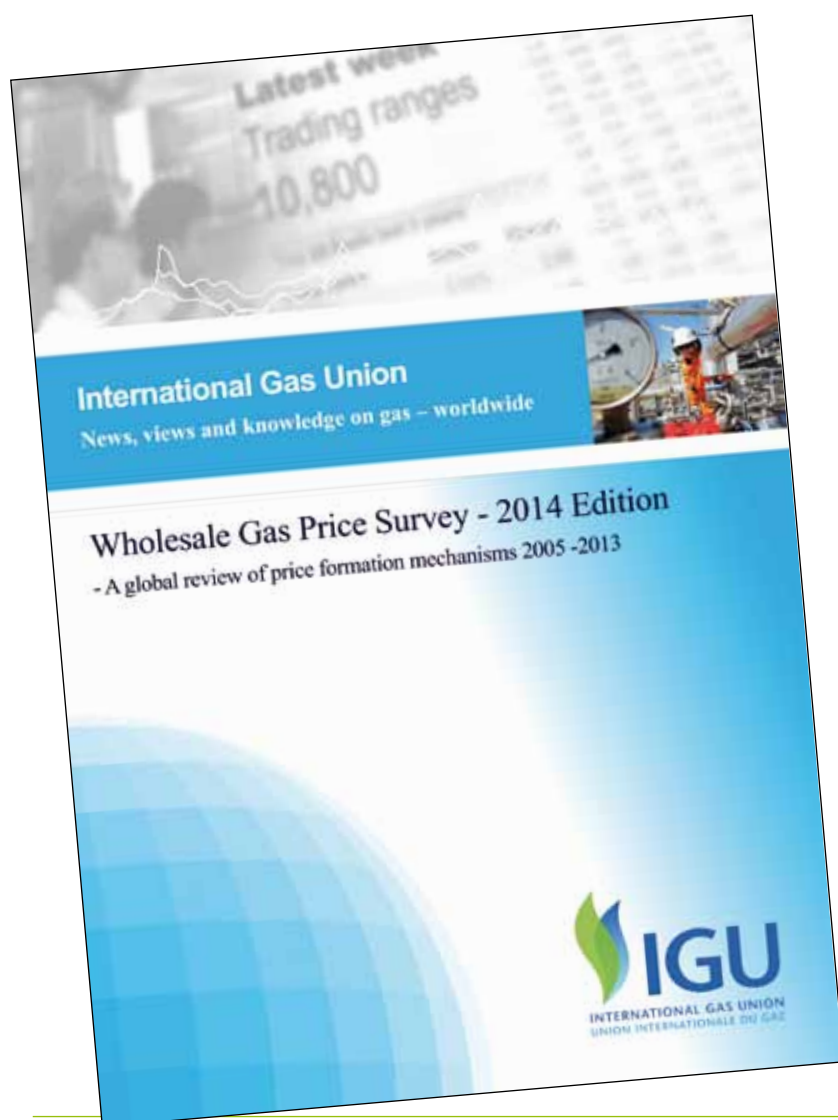
IGU's survey of wholesale gas prices in 2013 is the sixth to be undertaken in a series which began at the start of the 2006-2009 Triennium. Prior to the 2013 survey, previous ones covered

the years 2005, 2007, 2009, 2010 and 2012. The six surveys are now indicating the dynamic trends in wholesale price formation mechanisms over a period of rapid and significant change in the global gas market. In the 2013 survey responses were received for 65 out of 108 countries, but these responses covered 93% of total world consumption.

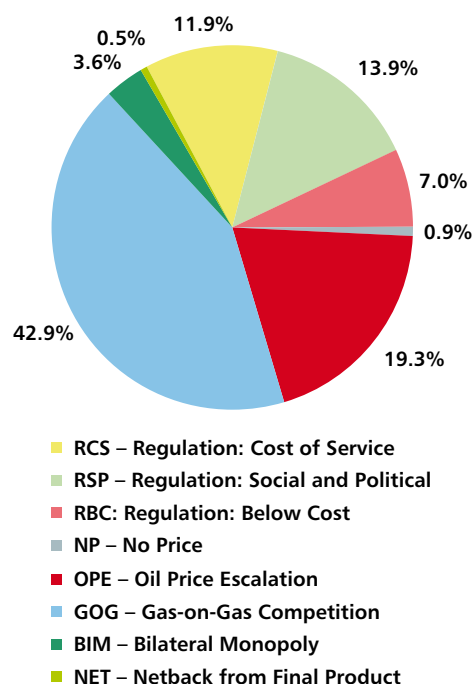
The 2013 survey showed again that gas-on-gas competition has the largest share in the world gas market (see *Figure 1*). Out of total world consumption of some 3,480 bcm, gas-on-gas competition has a share of 43%, totalling around 1,490 bcm, dominated by North America at 905 bcm, followed by Europe at some 280 bcm and the Commonwealth of Independent States (CIS) at around 185 bcm. In all gas-on-gas competition can now be found in 42 countries, in one form or another, and in all regions except Africa.

The share of oil price escalation or oil indexation stands at some 19% and totals around 670 bcm. It is found in 58 countries and in all regions except North America. In Europe oil price escalation accounts for 227 bcm, in Asia-Pacific 216 bcm and in Asia 118 bcm.

The three regulated categories – regulation cost of service, regulation social and political and regulation below cost – account in total for 33%, or around 1,145 bcm; with regulation cost of service in 16 countries, mainly the CIS (Russia) and Asia (China); regulation social and political in 24 countries, with the Middle East dominating – Iran, Saudi Arabia and the UAE; and regulation below cost in 15 countries, mainly the CIS – Kazakhstan, Turkmenistan and Uzbekistan, Africa – Egypt, Algeria and Nigeria, and Latin America – Venezuela.



World Price Formation 2013



Changes in price formation mechanisms

The share of gas-on-gas competition increased by almost 2.5 percentage points between the 2012 and 2013 surveys with a big move in Europe away from oil price escalation, and a rise in the share in Russia, being partly offset by a decline in spot LNG imports in Asia and Asia-Pacific.

Overall during the 2005 to 2013 period, the share of gas-on-gas competition has risen by 12 percentage points, while oil price escalation has declined by 5 percentage points. Bilateral monopoly has declined by 2.5 percentage points, while in the regulated categories regulation cost of service has risen by over 11 percentage points, regulation social and political has risen by almost 2 percentage points and regulation below cost has declined by 18 percentage points (see Figure 2).

The major overall changes, in the 2005 to 2013 period, have been the continuous move away from oil price escalation to gas-on-gas

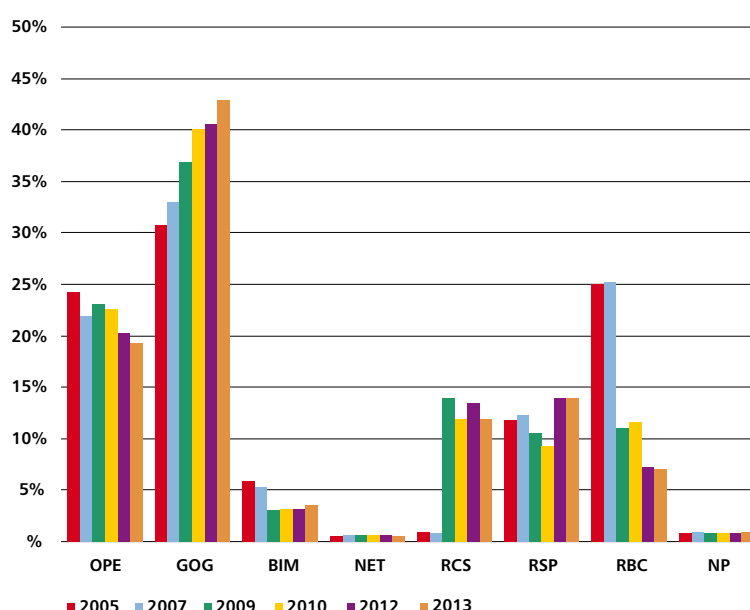
competition in Europe, and also in Russia as the independents and Gazprom competed for sales to large eligible customers such as power plants. This is clearly a different kind of gas-on-gas competition from the liquid trading markets in North America and Europe but reflects the fact that there are multiple buyers and sellers, distinguishing it from the bilateral monopoly category, where there would be a single dominant buyer and/or seller.

In Europe there has been a broadly continuous move from oil price escalation to gas-on-gas competition since 2005, with the latter's share increasing from 15% in 2005 – when oil price escalation was 78% – to 53% in 2013 – when oil price escalation had declined to 43%. The changes have reflected a number of factors over the years; initially a decline in the volume of gas imported under the traditional oil indexed contracts, being replaced by imports of spot gas and increasing volumes traded at hubs, followed by the ending of contracts or the renegotiation of the terms to include a proportion of hub/spot price indexation in the

◀ Figure 1.

▼ Figure 2.

World Price Formation 2005 to 2013



► Northwest Europe has seen the most dramatic change in price formation mechanisms – a trading floor in Germany.



pricing terms, or even a move to 100% hub price indexation, and in some cases, a reduction in the take-or-pay levels.

The change in price formation mechanisms in Europe was not universal across the region. Northwest Europe has seen the most dramatic change in price formation mechanisms, with a complete reversal from 72% oil price escalation and 27% gas-on-gas competition in 2005 to 20% oil price escalation and 80% gas-on-gas competition in 2013, as a result of increased hub trading and contract renegotiations, as noted above, most notably in the Netherlands where gas-on-gas competition was 100% in 2013. Central Europe has also, more recently, seen significant changes. Oil price escalation has declined from 85% in 2005 to just under 35% in 2013, while gas-on-gas competition has increased from almost zero in 2005 to over 50% in 2013, principally reflecting increased imports of spot gas, often from Germany, with some element of contract renegotiation. There has been much less change in other areas of Europe such as the Mediterranean (Greece, Italy, Portugal, Spain and Turkey), where oil price escalation has only declined from 100% in 2005 to around 85% in 2013 with gas-on-gas competition rising from nothing to just over 15%. This largely reflects spot LNG imports with

some spot pipeline imports into Italy, as well as changes in the pricing of domestic production in Italy. In Southeast Europe there is still no gas-on-gas competition.

While oil price escalation has lost share in Europe and, to a much lesser extent, in Asia-Pacific, there have been gains in share in Asia with a rise from 34% to 41% between 2005 and 2013 as China began importing LNG and pipeline gas, and initiated domestic pricing reform in two provinces, together with India's pricing for LNG from Qatar changing.

For intra-regional trade in the CIS, pricing mostly switched from bilateral monopoly – effectively annual fixed price arrangements – to oil price escalation around 2009. Finally in the Middle East there have been very small amounts of oil price escalation since 2009 when pricing under the Turkmenistan to Iran contract changed.

Apart from the changes concerning gas-on-gas competition and oil price escalation in Europe and Asia-Pacific, there have also been significant changes in the regulated pricing categories. The increases in regulated pricing and policy changes in Russia not only saw a switch towards gas-on-gas competition, but also a switch from subsidised regulation below cost in 2009 to regulation cost of service as

Gazprom finally stopped losing money on their domestic gas sales.

There were also significant changes in China as pricing reforms, again around the 2009 period, saw domestic production prices being more formally regulated and the price formation mechanism changing from regulation social and political to regulation cost of service. Similarly, and more recently, in Iran prices were raised significantly with the category changing from regulation below cost to regulation social and political in 2012.

Changes in wholesale prices

The rise in wholesale prices in Europe and Asia-Pacific over the last few years, and the decline in US prices, has been well documented and studied, but prices have also risen in Asia, largely due to price increases in China, particularly, and India, both as more gas was imported and regulated domestic prices were increased (see Figure 3).

Less well documented, however, has been the general rise in prices in other regions, such as Latin America, where average prices have more than doubled and in the CIS, where average prices have almost tripled, largely due to the rise in regulated prices in Russia, as they move towards the netback value from Europe. In Africa, where over 85% of prices are effectively subsidised, there have also been increases, with the largest consumer, Egypt raising prices, although remaining with subsidies, and Nigeria following suit more recently. In the Middle East, prices have risen slowly, with a significant increase in 2012 over 2010, as a result of the regulatory changes in Iran, which were maintained in 2013.

Analysis of changes in gas-on-gas competition

Gas-on-gas competition is not one homogenous category, and while the dominant mechanism can be considered as trading, as in the North American and European markets, there are also

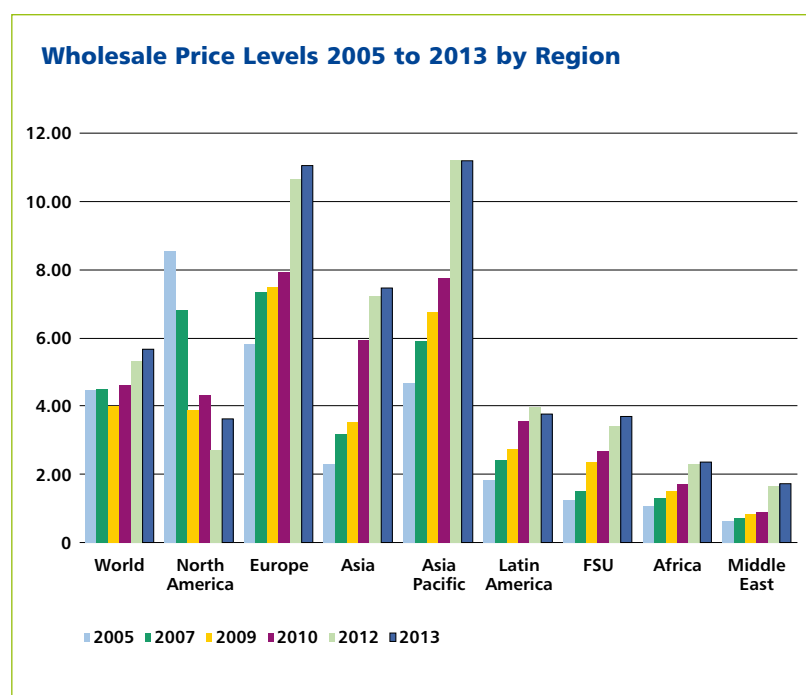
markets where there is no hub trading but there are multiple buyers and sellers entering into bilateral agreements – Australia, Russia and Argentina, plus spot LNG imports.

Out of the increase in gas-on-gas competition of 12 percentage points between 2005 and 2013, 6.1 percentage points have come from the bilateral category, 4.3 percentage points from trading – entirely in the European market – and 1.6 percentage points from spot LNG. The changes in the bilateral category in Russia and Argentina are the principal examples of changes in pricing mechanisms away from “regulated” pricing to “market” pricing. Outside of these the changes have generally been within the larger groupings of “regulated” and “market” pricing.

A further survey covering 2014 will be carried out prior to WGC 2015.

Mike Fulwood, Principal Global Gas with Nexant, is the leader of Study Group B.2 in Programme Committee B – Strategy. The complete Wholesale Gas Price Survey – 2014 Edition can be downloaded from www.igu.org.

▼ Figure 3.



Solve Complex Offshore Challenges with UOP's Gas Technology Expertise

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Watch the video



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Drawing on UGS Experience to Store Renewable Energy

By Jacques Grappe

Governments around the world are setting ambitious targets for the share of renewables in the energy mix but today's main renewable energy sources – wind and solar – are intermittent and their electricity production is difficult to predict. Gas-fired power generation is already providing reliable back-up when the wind isn't blowing or the sun isn't shining; now the gas storage sector is looking at ways to help when favourable weather conditions mean surplus electricity is generated.

With current technology there is no way to store large quantities of electricity so it has to be converted into another energy vector for storage. The gas industry has nearly a century of experience of underground gas storage (UGS) in porous reservoirs, salt and rock

caverns, which contributes to security of supply by allowing supply and demand to be balanced over a wide range of timescales. UGS facilities store large volumes of natural gas at reasonable cost, with very strong safety and reliability records, high flexibility, a low environmental footprint and emissions, minimal land occupation and good public acceptance. Working Committee 2 is looking at the extent to which UGS techniques can be used to store surplus energy generated from irregular renewable sources.

Most studies of future storage needs linked to renewable energy agree that capacity of an order of magnitude of at least tens if not hundreds of terawatt hours (TWh) is needed. To put this into perspective, the global UGS

► The gas industry has nearly a century of UGS experience – surface equipment at the Epe salt cavern facility in Germany.



capacity in 2013 was in the order of 377 bcm (4,150 TWh), i.e. some 11% of global gas consumption, whereas the maximum hourly deliverability was some 0.28 bcm (3,100 GW). There are three main electricity storage solutions readily available or requiring limited R&D efforts with which UGS experience can help.

Pumped hydroelectric storage (PHS)

PHS is currently the largest contributor to electricity storage (125 GW; 400 facilities). Surplus electricity is converted to potential energy by pumping water from a low-retention basin to a higher basin. The potential energy stored is retrieved and re-converted to electricity via hydraulic turbines during peak demand periods. Implementation requires a mountainous environment or coastal cliffs. Individual PHS facilities can be scaled from 10 MW to a few GW over a few hours/days. They offer a fast response (a few minutes), efficiency of 70-80%, a long service life (50 years+) and unlimited cycle stability.

As an alternative, underground storage schemes have been suggested, including salt caverns with a surface brine pond, rock caverns (lined or unlined) and disused mines. However, the requirement for large flow rates, large diameter shafts and high-performance pumps, together with economics and relatively limited capacity underground, limit the potential for development.

Compressed air energy storage (CAES)

CAES is an attractive solution for peak shaving but is not suited for long-term (seasonal) electricity storage. Electricity is converted into potential energy by using electric compressors to compress air which is stored underground and released during peak consumption hours. The energy of the stored compressed air is recovered by mixing it with natural gas, combusting the mixture and expanding it in a gas turbine. CAES offers a response time in the order of one minute, efficiency ranging from



40% for first generation facilities to 70% for the latest pilot projects, a minimum service life of 30 years and high cycling stability.

There are currently two operational CAES facilities:

- ◆ Huntorf, Germany. Built in 1978, this has an efficiency of 42%, two caverns (150,000 m³) with a capacity of 0.66 GWh each (330 MW for two hours) and a pressure range of 50 to 70 bar.
- ◆ McIntosh, Alabama, USA. In this second generation CAES facility commissioned in 1991, the compression heat is partly recovered, resulting in an energy efficiency of some 54%. One 540,000 m³ salt cavern is operated between 45 and 75 bar with a capacity of 2.9 GWh (110 MW for 26 hours).

The main CAES technologies under development are adiabatic and isothermal.

In the case of adiabatic CAES (ACAES), the compression heat is stored on the surface in a specific material and released during emission into the stored compressed air flow. This eliminates fossil fuel burning to heat the air after decompression and improves energy efficiency up to 70%. The technological issues still partly

▲ There are several pilot isothermal CAES projects in the USA. This is SustainX's 1.5 MW facility in Seabrook, New Hampshire.

unresolved include reaction of the salt caverns to quick cycling of massive air flows inducing quick pressure and temperature change, heat storage at a temperature of typically 600°C, development of efficient and reliable ACAES adapted turbines and mitigation of corrosion issues in the whole system. There are several pilot projects around the world such as ADELE in Germany involving RWE Power, GE, Züblin and the German Aeronautics and Space Research Centre (DLR). However, the large towers needed for heat storage may be a handicap in terms of public acceptance.

With isothermal CAES, temperature fluctuations are limited. There are several pilot projects in the USA. At SustainX's 1.5 MW facility in Seabrook, New Hampshire, the heat produced during compression is captured, trapped in water and the warmed air-water mixture is stored in pipes. When electricity is needed, the process reverses and the air expands, driving a generator. As with ACAES, no fossil fuel is needed to reheat the air. SustainX is pursuing the use of lined rock caverns and shafts for their commercial installations. The pressure in these storage volumes cycles between 60 and 207 bar.

▼ Hydrogen has a wide range of uses as an energy carrier.



Another example is the 2 MW (500 MWh) project operated by General Compression, with ConocoPhillips as a partner, in Gaines, Texas.

UGS experience

The gas industry's UGS experience can be drawn on for the sub-surface part of the facility.

As regards salt caverns, the industry is well-versed in their design, construction and operation and the behaviour of salt. The technology is proven and only requires some adaptations.

For mined caverns (or disused mines) the key issues for applicability of unlined technology, besides construction cost, are stability of the caverns and hydraulic containment under rapid pressure cycling over a wide pressure interval. Adding a liner would allow applicability of lined-rock cavern CAES to most geological environments, but at the cost of a significant capex increase.

Aquifer storage and depleted reservoirs are not considered as viable options.

Obstacles

Obstacles to a wide implementation of CAES include cost and geographic/geological constraints. CAES facilities need to be located at "sweet spots" of the grid at reasonable distances from both intermittent renewable energy production sources and the high voltage electric transportation system in order to avoid high connection costs, especially if buried power lines have to be considered.

For CAES in salt-leached caverns, rated the most favourable option, a minimum aggregated critical storage size is needed in case of a greenfield development to offset the cost of the leaching infrastructure. Moreover, developing new CAES sites could be further handicapped by lengthy and highly uncertain public consultation and permitting processes. Conversion of existing salt caverns or creation of new caverns as an extension of existing cavern fields will thus likely be the primary target for future projects.

Power-to-gas (P2G) – hydrogen

Surplus electricity can be used to produce hydrogen (and oxygen) via water electrolysis. The efficiency of the process is in the order of 60% with about 1 MWh required to produce 200 m³ of hydrogen. The gravimetric energy content of hydrogen is close to three times that of pure methane, whereas its volumetric energy density is much lower. Besides its use as feedstock for the petrochemical and fertiliser industry, hydrogen has a wide range of uses as an energy carrier:

- ◆ Hydrogen is a clean-burning fuel (combustion of H₂ does not generate CO₂);
- ◆ Hydrogen can be injected into the gas grid and blended into the natural gas stream. The European Gas Research Group (GERG) is currently preparing standards defining limits for the percentage of hydrogen acceptable without damaging gas networks, ancillary equipment and users' appliances;
- ◆ There is a P2G option which consists of producing synthetic methane gas (SMG, or pure CH₄) from hydrogen generated through water electrolysis and CO₂ captured from an industrial user or a power plant, although the energy efficiency of the process is low (typically around 10 to 15%);
- ◆ Hydrogen can also be converted into synthetic hydrocarbon fuels ("synfuels").

UGS experience

The UGS option for hydrogen generated from surplus electricity is only applicable for massive storage. For example, one 500,000 m³ cavern with a typical 120 bar operating pressure range can accommodate 45 million m³ of hydrogen (4,000 tonnes/135 GWh) or 60 million m³ of natural gas (700 GWh).

The above figures show that overall hydrogen storage in salt caverns is less efficient than for natural gas. Furthermore, hydrogen compression requires eight times more energy than natural gas and the high value of hydrogen (about 20 times that of

natural gas) will impact the cost of cushion and of trapped gas.

Currently, three underground hydrogen storage sites are in operation and a fourth is under construction – all in salt-leached caverns – to store feedstock for the local petrochemical industry:

- ◆ Teesside, UK (SABIC Petrochemicals), operating since 1971 with a working gas capacity of 965 tonnes (29 GWh);
- ◆ Clemens Dome, Texas, USA (ConocoPhillips), operating since 1983 with a working gas capacity of 2,600 tonnes (86 GWh);
- ◆ Moss Bluff, Texas (Praxair), operating since 2007 with a working gas capacity of 3,700 tonnes (122 GWh); and
- ◆ The Spindletop Dome project under construction near Beaumont, Texas (Air Liquide).

These facilities can provide operational feedback on hydrogen storage in salt caverns; and the natural gas industry can call on the historical experience of storing town gas (a mixture of methane and up to 60% hydrogen produced from coal) in salt caverns and porous reservoirs. Salt is known not to interact with, and not to be permeable to hydrogen. The feasibility of underground hydrogen storage

▼ This 2 MW power-to-gas unit in Falkenhagen, Germany is a joint venture of E.ON and Swissgas.



can thus be considered proven, at least for caverns leached in pure salt. Some questions remain as to the hydrogen tightness of bedded salt formations or of salt bodies displaying massive occurrence of insoluble minerals, which need a site-specific investigation.

Some of the physical properties of hydrogen are identified as unfavourable to UGS applications and require mitigating actions and/or dedicated R&D efforts. These include:

- ◆ High fugacity (containment issues in the cemented annulus of production wells);
- ◆ Metal embrittlement through hydrogen-induced cracking (HIC) which calls for adapted metallurgy. Experience exists in the industry to tackle this issue;
- ◆ The chemical activity of hydrogen may adversely interact with synthetic seals in the well completions;
- ◆ Dissolution of water in the stored hydrogen may require some dehydration process. Conversely, dissolution of hydrogen in the formation water or in brine may lead to acidification problems;
- ◆ Hydrogen is highly flammable with a low activation energy and will require setting up approved rules for evaluation of safety distances in case of accidental release (these are believed to be within those in force for natural gas).

There are additional issues – which could be showstoppers – relating to the injection of hydrogen-enriched natural gas in gas grids and reservoir storage infrastructures. These include:

- ◆ Interaction with pyrite and sulphur-bearing minerals or formation water might generate H_2S and lead to mineral deposit and clogging of the pore space in the reservoir;
- ◆ Fugacity of hydrogen might allow migration across the sealing formation;
- ◆ The low viscosity and high mobility of hydrogen could impact the sweep efficiency in the pore space, and generate extensive fingering and lateral gas escape across spill points;

- ◆ The risk of bacteriological activity and of biodegradation of hydrogen to methane (which occurred in town gas storage facilities);
- ◆ Part of the injected hydrogen used as cushion gas will remain permanently trapped in the pore space and a fraction of the stored hydrogen will dissolve in the formation fluids leading to economic losses.

National or EU-funded R&D projects aimed at evaluating the feasibility of underground hydrogen storage from a technical, economic and regulatory standpoint and at identifying technology gaps are ongoing, such as InSpEE (Germany), HyUnder (international consortium) and pilot projects Falkenhagen and Thüga Mainova (Germany).

Hydrogen storage in salt caverns is the most mature option. Additionally, synergy may be found from extending natural gas cavern fields or from converting former natural gas caverns to hydrogen, and, in the case of a “green methane” scheme, to CO_2 and oxygen caverns.

Storage in porous reservoirs may be feasible, but there are major uncertainties which need to be assessed and resolved by targeted R&D efforts. The first pilot demonstration plant with a real injection of a mixture of natural gas and hydrogen into a depleted gas field and its subsequent withdrawal is going to be built in Austria under the Underground Sun storage project. Run by a consortium led by RAG AG, the project will assess the impact of hydrogen on UGS reservoirs based on data from in-situ testing under real conditions.

Unlined rock caverns seem to be an unviable option, whereas lined caverns, like the 40,000 m³ GDF Suez natural gas facility in Skallen, Sweden, would be expensive to build and are not yet a demonstrated solution for hydrogen. An attractive alternative for small to medium hydrogen storage volumes (a few thousand m³ capacity i.e. up to a few GWh energy content) could be provided by high pressure storage in underground tubes, derived from surface and



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sub-surface storage techniques already implemented for natural gas storage.

Based on the above, the technology is there (or nearly there) to extend some of the UGS natural gas techniques to hydrogen in order to provide a versatile, flexible solution for massive storage of intermittent electricity. In terms of quantity, deliverability and response time, this would offer a unique opportunity to achieve the integration of the electricity and natural gas grids through conversion of surplus electricity either to hydrogen or to SMG.

Obstacles

However, there are obstacles to the development of a stabilisation process of electricity grids via underground hydrogen storage.

The deployment of UGS storage techniques requires implementation of large capacity hydrolysers. A typical salt cavern has a working gas capacity of some 50 million m³ of hydrogen, while as of today, demonstration hydrolyser facilities such as Falkenhagen (2 MW capacity) only achieve a hydrogen production rate in the order of 360 Nm³/hour (i.e. it would take some 15 years to re-fill the cavern!). A significant R&D effort leading to technological breakthroughs is needed to increase the performance of hydrolysers and significantly reduce their cost.

Hydrogen produced from electricity may most efficiently be used as pure hydrogen rather than as “green methane” or for re-electrification. Developing the use of hydrogen would require the creation of a hydrogen pipeline network entailing significant investment, permitting and public acceptance issues.

Injection of some hydrogen into the existing natural gas grid faces obstacles which are not likely to be resolved in the short term. Based on current evaluations injecting up to 5% vol. hydrogen (and possibly up to 10%) into gas flows in the natural gas grid is deemed feasible, whereby storage caverns could contribute to enhance stability of the mix. A major R&D investigation effort is required to define the actual percentage of hydrogen acceptable without damage to natural gas infrastructure and end-user applications. Setting up harmonised regulations at European level is another critical prerequisite if hydrogen blending into the natural gas grid is to be widely implemented as a cross-border option requiring interoperability. Conversely, hydrogen blending might only be considered at local grid scale, in which case large storage volume would probably not be needed.

Conversion of hydrogen to “green methane” would allow maximum advantage to be taken

► Projects evaluating underground storage of hydrogen include HyUnder.





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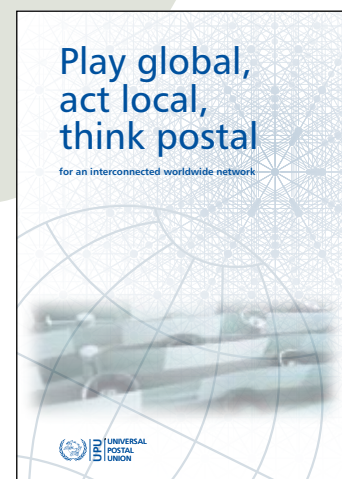
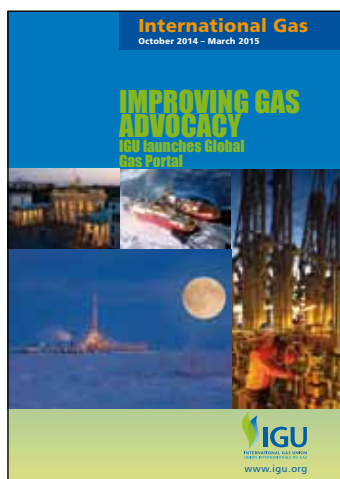
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of existing gas infrastructure, but the energy efficiency of the process is quite low, homogeneity of the methane/hydrogen mix remains an issue and economics, even with free surplus electricity, do not support the option under current market conditions.

Recent studies (in particular the EU-supported HyUnder project and publications by the Fraunhofer Institute) show that electricity storage via hydrogen production or SMG does not offer a real business case. The only potentially profitable application identified under current market conditions is the use of hydrogen for mobility. Whether this option will call on UGS remains an open question.

To make any flexibility measure to balance intermittent energy generation profitable, there has to be a market mechanism that values and rewards the flexibility/capacity that energy storage offers. In the current market there is no incentive to invest in these measures, even though the growing share of renewable energy does necessitate the development of these measures.

Deploying UGS experience

UGS can provide answers to large-scale integration of intermittent renewable energy sources and storage of electricity at all time, capacity and deliverability scales, provided the energy quantities to store are large enough.

However, it is unclear what the market needs will be, and to what extent UGS solutions will match future demand, if one excludes a few large storage facilities to be constructed at “sweet spots” in the electricity grid.

Key unresolved issues for the level of deployment of UGS solutions include the extent to which intermittent electricity generation from renewable sources will be centralised or dispersed and the resulting volatility. In the case of widely dispersed renewable sources, it can be expected that small, dispersed storage in surface pressure vessels or innovative solids such as hydrogen hydrides rather than large-scale UGS will be implemented. Demand-side

management (e.g. smart heat pumps and domestic appliances switched on and off depending on electricity price and availability on the grid, etc.) and energy savings could also reduce volatility; and so will the integration of networks and emerging smart grid management technologies.

On top of the above issues, future pricing of energy, new “rules of the game” and regulations yet to be invented, could lead to new business models which, together with long-term energy policies, will dictate future UGS needs triggered by intermittent renewable electricity production.

Additionally, the UGS industry could take advantage of its current know-how to extend its field of services to other energy storage techniques such as geothermal heat storage in aquifers or dry rocks, to sub-surface monitoring, and in the wider perspective of a decarbonised energy society, to CO₂ sequestration. All these technologies call on disciplines in use in the UGS industry such as sub-surface, well and completion engineering, reservoir engineering, geochemistry, environmental impact monitoring, surface and process engineering, and facility operation. The extensive experience of the UGS industry with permitting processes might be considered a further feather in its cap.

However the future evolves, our industry is ready to face the change and to respond to the challenges ahead with a combination of experience and technology-driven innovation.

Jacques Grappe of Géostock is a member of Working Committee 2 – Storage. The following WOC 2 members made important contributions to the paper on which this article is based: Hélène Giouse (Storengy), Nikita Barsuk (Gazprom), Fabien Favret (EDF) and Ladislav Goryl (Nafta and Chair of WOC 2). A fully developed version of the full paper will be published for WGC 2015 as part of the report of Study Group 2.2 (Techniques and New Opportunities).



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Emerging Players in Arctic Gas Development

By Georgia Lewis

Norway and Russia currently have the only gas production facilities inside the Arctic Circle but there is much more potential in the region if environmental, geopolitical and technical challenges can be overcome.

The Arctic represents the last frontier for gas operators looking for new opportunities. The US Geological Survey (USGS) has estimated that the region may hold up to 22% of the world's undiscovered, technically recoverable oil and natural gas resources.

Eight countries have territories within the Arctic Circle – Canada, Greenland (an autonomous country within the Kingdom of Denmark), Finland, Iceland, Norway, Russia, Sweden and the USA – and they have joined forces in the Arctic Council. China, with its growing economic power, also has the potential to be an important player. It is an Arctic Council observer and has invested in Yamal LNG.

▼ Icebreakers of the US (*Healy*) and Canadian (*Louis S. St-Laurent*) coastguards carrying out a joint survey in the Arctic.



The technical challenges associated with extracting gas in inhospitable and remote conditions are clear. However, operators and governments also need to deal with geopolitical issues – especially in relation to overlapping claims to extended continental shelves.

Under the UN Convention on the Law of the Sea (UNCLOS), which has been ratified by all the Arctic states except the USA, coastal states have exclusive sovereign rights over the continental shelf for the purposes of exploration and exploitation. UNCLOS sets out criteria for establishing the continental shelf, which may extend up to 350 nautical miles (648km) from a state's coast line.

Additionally, the ecologically sensitive areas where Arctic gas exploration and extraction take place create a need for regulations that take into account environmental concerns and respect the culture and lifestyle of local residents. Community engagement programmes instigated by operators largely focus on striking a balance between protecting the environment and communities while offering opportunities for local residents to benefit from hydrocarbon development.

Current production

Norway started Arctic gas production in 2007 when the Snøhvit project came onstream. It is operated by Statoil with Petoro, Total, GDF Suez and RWE as partners. Snøhvit was the first major development on the Norwegian Continental Shelf (NCS) with production facilities on the seabed. Gas is produced from the Snøhvit and Albatross fields beneath the Barents Sea and transported via a 143km pipeline for processing on the island of Melkøya. The seabed



◀ With the Antarctic reserved for scientific research, the Arctic is the last frontier for gas operators looking for new opportunities.

facilities were designed to be over-trawlable, so that neither they nor fishing equipment can be damaged if they come into contact. On Melkøya CO₂ is removed from the gas stream and piped back to the NCS for injection into the 2,600m-deep Tubåen formation. The natural gas is then liquefied in a single-train plant with a capacity of 4.2 mtpa. However, the plant has

suffered from a series of technical problems and has so far failed to reach this capacity. Production in 2013 was 2.8 mt.

Looking ahead, work on adding production from the Askeladd field to the Snøhvit project will start in 2015, while Statoil is developing the Aasta Hansteen field in the Norwegian Sea, just north of the Arctic Circle, which will be connec-



► Arctic operators need to take measures to protect local wildlife and the environment.

ted by the 480km Polarled pipeline to an onshore gas terminal at Nyhamna. Gas has also been discovered in the Norvarg and Skalle areas of the Barents Sea. Norway and Russia signed a treaty in 2010 to settle their differences over rights in the area.

Russia was going to tap Norwegian expertise to help develop the Shtokman LNG project to exploit resources beneath the Barents Sea, but this Gazprom-led venture is on hold for the time being. Russia's Arctic focus is on the Yamal Peninsula and its adjacent offshore areas where approximately 16 tcm of explored and preliminary estimated gas reserves and nearly 22 tcm of in-place and forecast gas reserves have been assessed.

Gazprom started production from the onshore Bovanenkovskoye field in 2012 with the gas sent out by pipeline, while exports of

LNG from the Yamal project are due to start in 2017. This is led by Novatek with CNPC and Total as partners. Both Gazprom and Novatek operate other gas fields in the Yamalo-Nenets Autonomous Okrug which are close to the Arctic Circle.

Yamal LNG is one of the largest industrial undertakings in the Arctic and involves the drilling of more than 200 wells to tap the onshore South Tambeykoye field and the construction of a gas gathering pipeline system, treatment facilities and three 5.5 mtpa liquefaction trains. A fleet of 16 ice-class (ARC-7) tankers, each able to transport 170,000m³, has also been ordered and the shipment infrastructure will include a jetty with two tanker loading berths at the port of Sabetta equipped with ice protection facilities. These will use the new Northern Sea Route, first used by an LNG carrier in 2012, which cuts sailing times to north-east Asia and can be used between July and November. For the other seven months of the year, LNG carriers will sail westwards to the Atlantic Basin.

Greenland's Arctic ambitions

Hydrocarbon exploration is not new to Greenland. The first test offshore drilling for oil



took place in 1976 but it was only in 2010 that Cairn Energy found gas and oil, albeit not in commercial quantities. This was also the year in which Greenland took over sole responsibility for its hydrocarbon resources from Denmark. In February 2014, the government released its oil and mineral strategy for 2014-2018.

Political developments in Greenland will influence the Arctic ambitions of multiple operators. When a coalition headed by Prime Minister Aleqa Hammond of the social-democratic Siumut Party came to power in March 2013, she expressed disapproval at the pace at which oil and gas exploration had been taking place. However, not long after the election, the Industry and Minerals Minister, Jens-Erik Kirkegaard clarified this stance, explaining that new licences would be issued as old ones expired.

Public opinion is divided in Greenland over how best to manage Arctic hydrocarbon development. A telephone survey of 721 Greenlanders commissioned by Oceans North for the Inuit Circumpolar Council-Greenland was conducted in late 2013 and found that 60% of the respondents either supported the current pace of offshore oil and gas drilling or believed it should be speeded up. In contrast,



◀ Greenland's Prime Minister Aleqa Hammond addressing the Arctic Frontiers conference.

40% said it should be suspended, scaled back or permanently halted. Respondents also expressed concern about how the government was informing the public about hydrocarbon development and ensuring safeguards are in place.

Then, in January and March 2014, Hammond gave clear signals that she is committed to sympathetic hydrocarbon development in Greenland.

In January, Hammond spoke at the Arctic Frontiers conference in Tromsø, Norway, where she said: "Let there be no misunderstanding, that it is my clear political priority to ensure

▼ Snøhvit is currently the only LNG production facility within the Arctic Circle. The sub-sea installations supply gas to this liquefaction plant on Melkøya Island.





▲ Drilling of the wells to supply Yamal LNG is underway.

that the people living in Greenland should be the beneficiaries of developments within the oil, gas and minerals sectors in Greenland which are taking place these years, and that the traditional lifestyles and culture of Greenland should not be compromised by current developments.

"I think it is also important to place these developments within the larger framework of how to develop industrial sectors in Greenland – an Arctic country with a small indigenous Arctic population which to this day has always lived in balance with nature – while ensuring that the health of its population and the sensitive Arctic environment are not adversely affected."

These statements were reiterated at the Arctic Summit in London in March with Hammond again describing as her "clear political priority" the combination of ensuring Greenlanders benefit from gas development and not compromising traditional lifestyles and cultures.

"I want Greenland to have a self-sustaining economy based on our own resources with a greater degree of integration into the world economy," she said. "These developments will also have wider implications for the Arctic as a whole."

As such exploration activities are moving ahead with 34 licence areas opened up. Expectations are high because, according to the USGS, estimated undiscovered volumes of natural gas are 1.4 tcm for West Greenland and 2.4 tcm for East Greenland.

Cairn has been working in Greenland since 2007 and has drilled eight wells. Gas has been encountered in thin sands in its first two wells in Baffin Bay offshore West Greenland. This discovery was announced as non-commercial but Cairn is still exploring. Moreover, Shell and Statoil are looking to ramp up their exploration work in the Greenlandic Arctic after buying into Cairn's Pitu licence in 2011.

The highest expectations are for East Greenland. Research indicates that this area is closely related geologically to the Norwegian Sea and Barents Sea basins. In December 2013, the government granted licences to three consortia in four blocks. They are: Statoil, ConocoPhillips and Greenland's national oil company Nunaoil (Avinngaq); BP, ENI, Dong Energy and Nunaoil (Amaroq); and Chevron, GreenPex, Shell and Nunaoil (Umimmak and Nerleq).

However, exploration in these promising regions won't be without enormous technical challenges because of the hostile conditions. These licence areas are located in the Fram Strait, which is the deepest gateway between the Arctic and other oceans, and experiences two alternating currents. Approximately 10-15% of the Arctic's total ice mass moves south via this strait every year. Conditions vary dramatically between the east and west parts of the strait throughout the year, with the west experiencing more ice-free days than the east. It is expected that any drilling operations that take place will require extensive ice management by ice breakers, which will add to the costs.

Greenland's politicians are debating the merits of relying on corporate taxation versus royalty payments, with Prime Minister Hammond saying that she favours a royalty-based approach. With exploratory activities costing operators millions with no commercial viability as yet, and the Prime Minister publicly committing to Arctic development that is sensitive to the environment and traditional cultures and lifestyles, Greenland's Arctic gas story is still unfolding.

Asian demand drives new Arctic LNG projects

At present, Norway is the sole exporter of LNG from the Arctic and only a small proportion (18% of 2013's output of 2.8 mt) goes to Asia. However, the expanding Asian markets will be a significant source of revenue for new projects. Russia is moving ahead with Yamal LNG and the US is also interested in developing Arctic LNG capability. Meanwhile, Canada is focusing its LNG activities outside the region and Finland, Iceland and Sweden have no active gas projects.

Some future US gas exports may ultimately come from Arctic operations despite the fracking boom in other parts of the country. BP, ConocoPhillips, ExxonMobil and TransCanada are in evaluating a project to take gas from the Prudhoe Bay field on Alaska's North Slope via a 1,300km pipeline to a liquefaction plant in south-central Alaska with a capacity of 15-18 mtpa. The pipeline would also supply local customers. However, the project has a \$65 billion price tag.

The Asian buyers are already jockeying for position. As we have seen, China has a stake in Yamal LNG and Korea could also benefit from a buoyant Arctic LNG sector. In 2012, then-Korean President Lee Myung-bak visited Greenland and Norway to sign memoranda of understanding on energy and shipbuilding. Moreover, Korea's DSME has the contract to build Yamal's LNG tankers.

Along with China, India, Japan, Korea and Singapore were granted observer status in the Arctic Council in May 2013. This is not only a sign of how important their support is for Arctic gas development, especially LNG, but also paves the way for greater economic and industrial cooperation.

China as the wildcard in geopolitical disputes

China may well be the wildcard nation in the race to develop hydrocarbon resources in the Arctic despite not possessing Arctic territory.



▲ The Urengoykoye field in Russia straddles the Arctic Circle.

The disputes between Arctic states over extended seabed claims could take decades to resolve and China has become a prominent advocate for making Arctic governance a global matter rather than one that is limited to certain nations. This internationalisation of the sovereignty of Arctic gas reserves may be welcomed by other countries keen to exploit opportunities in this area, especially from the developing world.

In the meantime, China has time to make its own investments, and to develop technology and expertise. In May, CNPC signed a landmark (and long-awaited) gas supply deal with Gazprom. The 30-year contract is worth more than \$400 billion and pipeline supplies are due to start in 2018. Initially they will come from East Siberian fields but Arctic developments could follow. For China, any plans to have a presence in the Arctic hydrocarbon market are part of a long-term strategy.

Looking ahead

Arctic hydrocarbon development remains a high-risk, high-cost venture but the rewards could be plentiful for committed operators, with emerging players making significant investments to match ambitions.

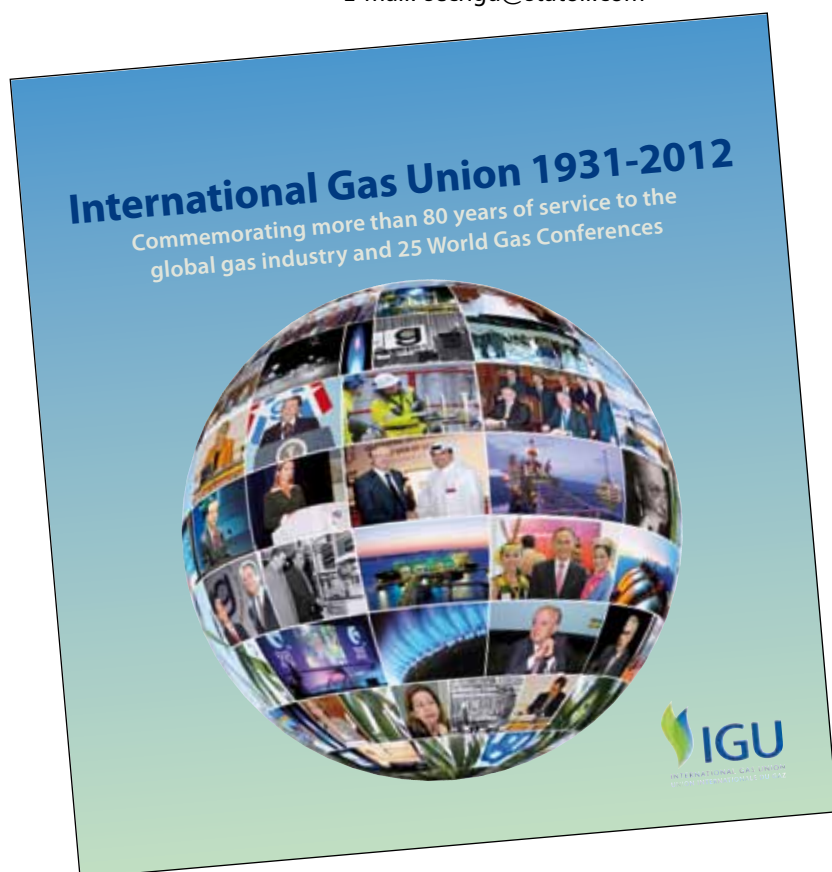
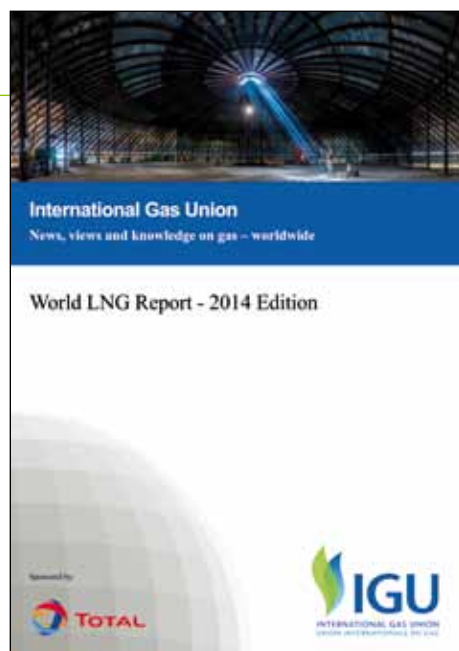
Georgia Lewis is the Managing Editor of International Systems and Communications.

Publications and Documents Available from IGU

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- ◆ IGU Articles of Association
- ◆ IGU Annual Report
- ◆ IGU Strategic Statement 2013
- ◆ IGU General Brochure (revised)
- ◆ Triennial Work Programme 2012-2015
- ◆ IGU Guiding Principles for Sustainable Development
- ◆ Natural Gas – Part of the Solution to Global Climate Change
- ◆ Natural Gas as a Transportation Fuel
- ◆ Natural Gas Unlocking the Low-Carbon Future
- ◆ World LNG Report – 2014 edition
- ◆ Wholesale Gas Price Survey – 2014 Edition, A Global Review of Price Formation Mechanisms 2005-2013
- ◆ Global Vision for Gas: The Pathway towards a Sustainable Energy Future
- ◆ IGU Natural Gas Conversion Guide
- ◆ IGU Natural Gas Conversion Pocketbook
- ◆ International Gas Union 1931-2012
- ◆ Shale Gas: The Facts about the Environmental Concerns

Reports for WGC 2012

- ◆ Final report of the 25th World Gas Conference
- ◆ Building Strategic Human Capital
- ◆ Everything You Wanted to Know about Gas ... but Were Afraid to Ask (Youth publication)
- ◆ Geopolitics and Natural Gas
- ◆ Natural Gas Industry Study to 2030: An Update on Supply, Demand and Trade
- ◆ Nurturing the Future Generations for the Oil and Gas Industry
- ◆ Reduction of Greenhouse Gases: A Technology Guide
- ◆ Renewable Gas: The Sustainable Energy Solution

Joint publications with other organisations

- ◆ The Role of Natural Gas in a Sustainable Energy Market (with Eurogas)
- ◆ Guidebook to Gas Interchangeability and Gas Quality 2011 (with BP)

Scientific and technical papers and documentation

- ◆ Sustainable Development and the Role of Gas (2006)



- ◆ Gas to Power Global Outlook, (2006)
 - ◆ The Art of Regulation, (2006)
 - ◆ Proceedings of the 23rd World Gas Conference, 2006, (CD-ROM)
 - ◆ Proceedings of the 22nd World Gas Conference, 2003
 - ◆ Proceedings of the 17th, 18th, 19th, 20th and 21st World Gas Conferences, (CD-ROM)
 - ◆ International Gas, ISC, all issues of the bi-annual IGU Magazine from 2004
- Please check the IGU website for other (older) publications which are still available from the IGU Secretariat.

IGU Events and Other Major Gas-related Events 2014-2016

2014 October 13-17 IPLOCA 48th Annual Convention Abu Dhabi, UAE October 14-17 IGU Council Meeting Berlin, Germany November 4-7 5th World Shale Oil & Gas Summit & Exhibition Dallas, USA November 18-20 GASEX 2014 Conference & Exhibition Hong Kong, China	November 12 4th IEF-IGU Ministerial Gas Forum Acapulco, Mexico December 1-12 20th Session of the Conference of the Parties to the UNFCCC (COP 20) Lima, Peru 2015 March 24-26 IGU Executive Committee Abu Dhabi, UAE	June 1 IGU Council Meeting Paris, France June 1-5 26th World Gas Conference Paris, France October (exact date TBC) IGU Council Meeting Cartagena de Indias, Colombia October 27-30 Gastech Conference & Exhibition Singapore	November 30-December 11 21st Session of the Conference of the Parties to the UNFCCC (COP 21) Paris, France 2016 April 11-15 LNG 18 Perth, Australia October (exact date TBC) 23rd World Energy Congress Istanbul, Turkey
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gas well in the Medvezhinskoye field in the Yamal-Nenets Autonomous Area).

Messages: French Presidency of IGU (10 & 11 upper), APPEA (11 lower), IGU (14).

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Rune Bjørnson running as Norway's candidate for the IGU Presidency 2018-21

"In light of the climate challenge, some say natural gas is a thing of the past. I believe they are very wrong," says Rune Bjørnson, senior vice president of Marketing and Trading in Statoil, and Norway's candidate for the IGU Presidency.

Making the case for gas

"I see natural gas playing an important role in finding a solution to our common energy and climate challenges. Gas can meet rising global energy needs and do so in a sustainable way," says Mr Bjørnson. "The coming years will be important for the role of gas in the global energy mix, and the need for an organization like IGU has never been greater," he continues.

Norway's candidate sees a lot of potential in IGU. "Our members combined make up the world's largest body of gas expertise. Based on a dialogue with our members and key decision and policy makers, IGU should develop and engage an agenda to promote the case for gas globally," he says.

"This is not a shift in direction", he continues. "Recent IGU presidencies have done an excellent job in providing fact-based information and opening new doors for IGU. Building on the French and American presidencies, we will emphasise IGU's external agenda in our work, making sure that the world's largest gas advocate has a voice to be heard. This external orientation must be supported by a long-term strategy that goes beyond our current three-year planning cycle. We will therefore look at our funding and financial models, and review our committee set-up and way of working to ensure that all parts support our strategy", Bjørnson says.

The candidate and his team

Rune Bjørnson is an accomplished gas industry executive, well known in international energy policy circles for promoting gas to meet the world's energy demand in a cost efficient and sustainable way. He has also been a driver for technical developments improving the competitiveness of gas in the global energy mix.

Bjørnson has held numerous senior management positions in Statoil's natural gas business since joining the company in 1985, including that of executive vice president for natural gas on Statoil's corporate executive



▲ Rune Bjørnson, Norway's candidate for the IGU presidency.

► The Norwegian IGU team: Egil Haaland, Rune Bjørnson and Runar Tjersland (from left).

committee. He is currently responsible for all marketing and trading of both oil and gas in Statoil.

Long-time Statoil delegate to the IGU committees, Runar Tjersland, has been nominated head of the coordination committee. He has been very active in various IGU committees since 2000. Tjersland has headed up study groups in working committees, most recently in programme committee B where he was responsible for IGU's first report on "Gas pricing and price formation". Tjersland has been a member of IGU's executive committee since 2011. Tjersland has 25 years' experience



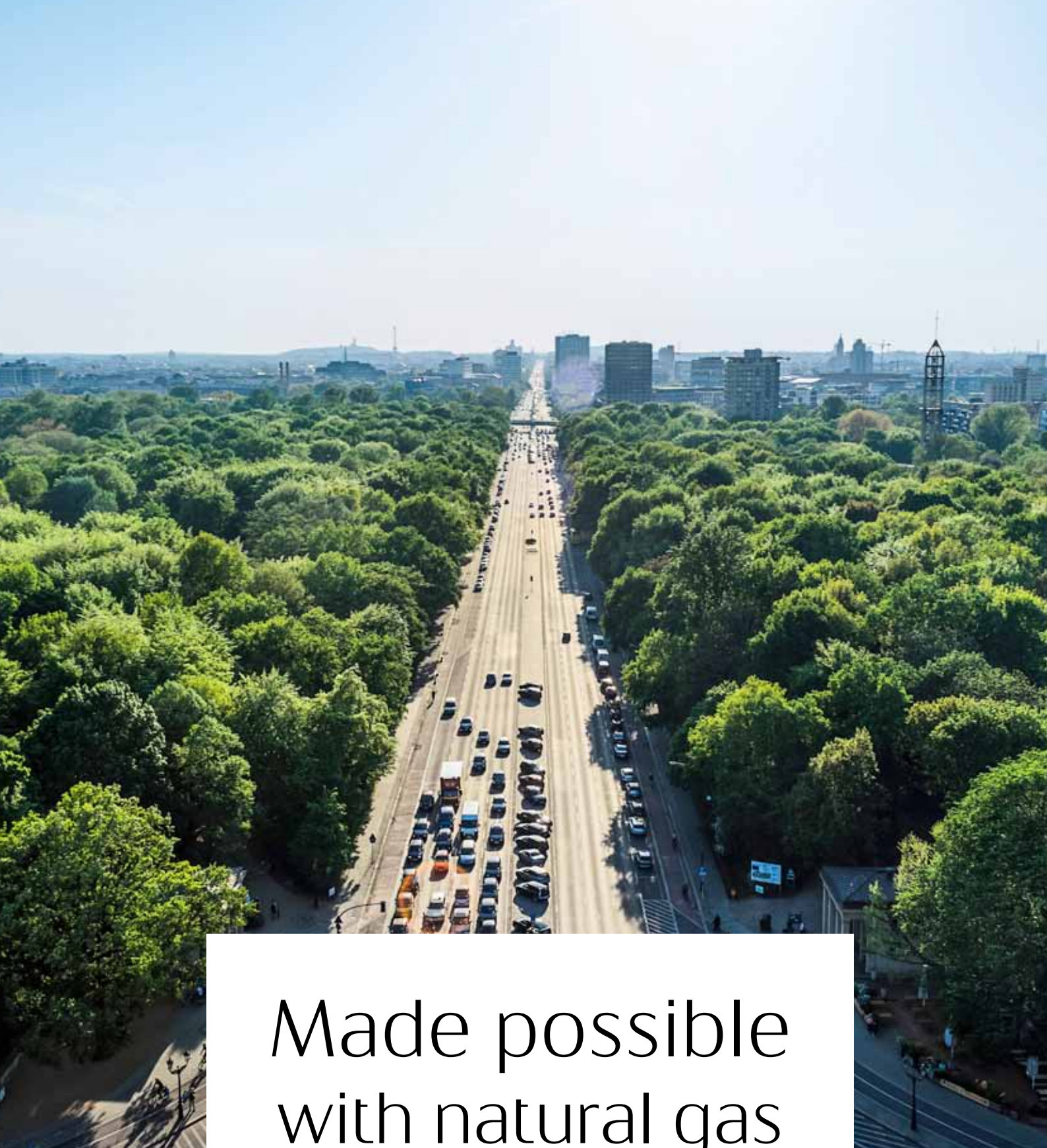
from various positions in Statoil's gas business, mainly focusing on strategy and market analysis.

President of the Norwegian Gas Association, Egil Haaland, is nominated head of the national organising committee. He has worked in Statoil's gas business since the 1980s, and has been responsible for gas contract negotiations as well as gas infrastructure development. Haaland recently returned from the US, where he served as project manager for midstream and downstream business development in the US and Canada.

The Norwegian team is running with strong support from the Norwegian government, as well as from regional stakeholders around Stavanger, who will host the WGC in 2021 if Norway's bid should win.

Norway's contributions to IGU

Norway has never held the IGU presidency before, but has a long heritage of supporting the Union, and has committed to funding and housing the IGU secretariat for a total of nine years. Norway and Statoil have a long-term commitment via senior personnel – including IGU executive committee member and coordination committee nominee Runar Tjersland. "Our commitment to IGU over many years reflects our faith in the organisation," Bjørnson says.



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